APRIL, 1926

62

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See description on page 76

Contractors' and Engineers' Monthly

WIDE WORLD PHOTO

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Where to Purchase

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment.
The Index to Advertisers faces the inside back cover. When writing to advertisers please mention the CONTRACTORS' & ENGINEERS' MONTHLY. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

AIR COMPRESSORS
*Am. Stm. Pump Co., Battle Creek, Mich.
*Buhl Co., Chicago.
*Curtis Pn. Mchy. Co., St. Louis, Mo.
*Domestic Eng. & Pump Co., Shippensburg, Pa.
*Ingersoll-Rand Co., N. Y.
*Novo Engine Co., Lansing, Mich.
*O. K. Clutch & Mach. Co., Columbia, Pa.
*Schramm, Inc., West Chester, Pa.
*Stover Mfg. & Eng. Co., Chicago.
*Sullivan Mchy. Co., Chicago
Allis-Chalmers Mfg. Co., Milwaukee.
Chicago Pneumatic Tool Co., N. Y.
Le Laval Stm. Turb. Co., Trenton, N. J.
De La Vergne Mach. Co., N. Y.
Fairbanks, Morse & Co., Chicago.
Gardner Governor Co., Quincy, Ill.
General Elec. Co., Schenectady, N. Y.
Hardie-Tynes Mfg. Co., Bmingham, Ala.
Nordberg Mfg. Co., Milwaukee.
Norwalk Ir. Wks. Co., So Norwalk, Ct.
United Iron Wks., Kans. City, Mo.
Westinghouse Trac. Brake Co., Wilmerding, Pa.
Worthington Pump & Mchy. Corp., N. Y.

ARC LAMPS
General Elec. Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARTESIAN WELL DRILLS & PUMPS
Am. Well Works, Aurora, Ill.

ASBESTOS PRODUCTS
*Philip Carey Co., Cincinnati.
Keasbey & Mattison Co., Ambler, Pa.
Mikesell Bros. Co., Wabash, Ind.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mountain Co., Chicago.

ASH HANDLING MACHINERY
*Bay City Dredge Wks., Bay City, Mich.
*Byers Mach. Co., Ravenna, O.
*Chicago Automatic Conv. Co., Chicago
*Geo. Haiss Mfg. Co., N. Y.
*Mack Trucks, Inc., N. Y.
*Lakewood Eng. Co., Cleveland, O.
*Mead-Morrison Mfg. Co., E. Boston, Mass.
*Orton Crane & Shovel Co., Chicago
C. O. Barlett & Snow Co., Cleveland, O.
Brown Hoisting Mach. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., E. Chicago, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago.
Portable Mach. Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.

ASPHALT
*Barber Asphalt Co., Philadelphia.
*Barrett Co., N. Y.
*Ky. Rock Asph. Co., Louisville, Ky.
*Standard Oil Co. (Ind.), Chicago.
*Texas Co., N. Y.
*Warren Bros. Co., Boston.
Atlantic Ref. & Asph. Corp., Phila.
Gulf Refining Co., Pittsburgh
Headley Good Roads Co., Phila.
New Orleans Ref. Co., New Orleans.
Pioneer Asph. Co., Lawrenceville, Ill.
Sinclair Ref. Co., Chicago.
Standard Oil Co. of Cal., S. Francisco.
Standard Oil Co. of La., N. Orleans.
Standard Oil Co. of N. J., Newark.
Standard Oil Co. of N. Y., N. Y.

ASPHALT BLOCK
Hastings Pavement Co., N. Y.

ASPHALT CUTTERS
*Ingersoll-Rand Co., N. Y.
*Sullivan Machinery Co., Chicago.
Dayton Pneum. Tool Co., Dayton, O.
Chicago Pneumatic Tool Co., N. Y.
Independent Pn. Tool Co., Aurora, Ill.

ASPHALT KETTLES (See Kettles for Asphalt and Tar Heating)

ASPHALT PLANTS, TOOLS, ETC.
*Aeroil Burner Co., Union Hill, N. J.
*Barber Asphalt Co., Philadelphia.
*Chausse Oil Burner Co., Elkhart, Ind.
*Littleford Bros., Cincinnati, O.
*Warren Bros. Co., Boston.
Edw. R. Bacon Co., S. Francisco.
Chase & Lyman, Boston.
F. D. Cummer & Son Co., Cleveland, O.
J. D. Farasey Co., Cleveland, O.
Hetherington & Berner, Indianapolis.

ASPHALT ROLLERS (See Road Rollers)

ASPHALT SURFACE HEATERS
*Aeroil Burner Co., Union Hill, N. J.
*Barber Asphalt Co., Philadelphia.
*Chausse Oil Burner Co., Goshen, Ind.
*Equitable Asp. Maint. Co., Kan. C., Mo.
*Hauck Mfg. Co., B'klyn, N. Y.

BACKFILLERS
*Am. Com. Mchy. Co., Inc., Keokuk, Ia.
*Baker Mfg. Co., Springfield, Ill.
*Bay City Dredge Wks., Bay City, Mich.
*Buckeye Trac. Ditcher Co., Findlay, O.
*Byers Machine Co., Ravenna, O.
*Construction Mchy. Co., Waterloo, Ia.
*Harnischfeger Corp., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Miami Trailer-Scraper Co., Troy, O.
*Orton Crane & Shovel Co., Chicago
Austin Mach. Corp., Muskegon, Mich.
Ersted Mchy. Mfg. Co., Portland, Ore.
Parsons Co., Newton, Ia.
Speeder Mchy. Corp., Fairfield, Ia.
Weller Mfg. Co., Chicago.

BAR BENDERS AND CUTTERS
*Koehring Co., Milwaukee, Wis.
*Ransome Conc. Mchy. Co., Dunellen, N.J.
Buffalo Forge Co., Buffalo, N. Y.
Concrete Steel Co., N. Y.
Electric Welding Co., Pittsburgh.
D. A. Hinman & Co., Sandwich, Ill.
J. L. Gleason & Co., Boston, Mass.
McKenna Co., Cleveland, O.

BAR CHAIRS, REINFORCING
*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., N. Y.
Universal Form Clamp Co., Chicago

BAR TIES
*Bates Valve Bag Co., Chicago.

BATCH BOXES
*Easton Car & Const'n Co., Easton, Pa.
*Lakewood Eng. Co., Cleveland, O.
Easton Car & Const'n Co. of Mo., Kansas City, Mo.
Western Wheeled Scraper Co., Aurora, Ill.

BINS, STORAGE
*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Rd. Mach. Co., Chicago.
*Blaw-Knox Co., Pittsburgh, Pa.
*Easton Car & Const'n Co., Easton, Pa.
*Erie Steel Const. Co., Erie, Pa.
*Fairfield Eng. Co., Marion, O.
*Galion Iron Wks. & Mfg. Co., Galion, O.
*Good Roads Mchy. Co., Kennett Sq., Pa.
*Ransome Conc. Mchy. Co., Dunellen, N.J.
*Russell Grader Mfg. Co., Minneapolis.
*Universal Rd. Mach. Co., Kingston, N. Y.
Austin Mfg. Co., Chicago.
Birmingham Tank Co., Bmingham, Ala.
Brown Hoisting Mchy. Co., Cleveland.
Link-Belt Co., Chicago.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Weller Mfg. Co., Chicago.

BLAST HOLE DRILLING MACHINES (See "Well Drilling and Blast Hole Machines")

BLASTING POWDER (See Explosives)

BLOCKS AND TACKLE
*Boston & Lockport Blk. Co., E. Boston, Mass.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*Western Block Co., Lockport, N. Y.
Upson-Walton Co., Cleveland, O.

Save Time and Money with Truscon Steel Road Forms

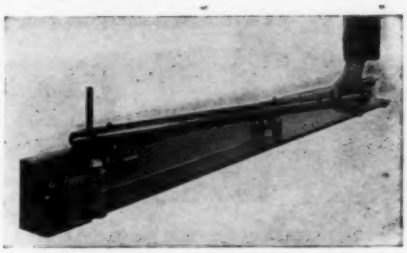
Take advantage of the time and money savings of the new and improved Truscon Steel Road Forms.

Truscon Steel Road Forms are made from 3-16-in. material throughout and all connections are securely riveted. Note particularly the sliding end connection and the bearing end which holds the form perfectly in line.

These Road Forms embody many outstanding improvements. Their simplicity saves time in placing. Their ample dimensions assure rigidity and durability. Their sliding connections provide perfect alignment. Truscon Steel Road Forms enable the contractor to do better work in quicker time and at lower cost.

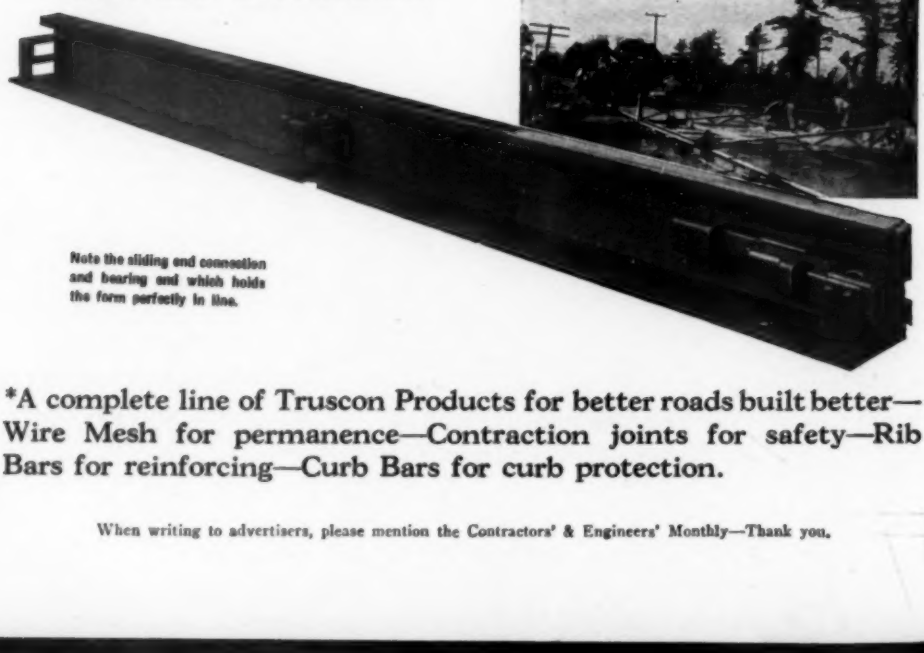
Truscon Steel Road Forms are built for permanent service. With ordinary care they will last indefinitely and are a permanent means for reducing your road-building costs.

Write for full details



Truscon Stake-Puller makes possible the pulling of stakes with one hand.

Truscon Steel Road Forms are easily placed and staked perfectly true.



Note the sliding end connection and bearing end which holds the form perfectly in line.

Where to Purchase

BLUE PRINT MACHINES
Paragon Mach. Co., Rochester, N. Y.
C. F. Pease Co., Chicago.
Revolute Mach. Co., N. Y.
Wickes Bros., Saginaw, Mich.

BOILERS
*S. Flory Mfg. Co., Bangor, Pa.
*Johnston Bros., Inc., Ferrysburg, Mich.
*Superior Body Corp., Marion, Ind.
Chandler & Taylor Co., Indianapolis.
Chatta. Boiler & Tank Co., Chatta., Tenn.
R. D. Cole Mfg. Co., Newnan, Ga.
Erie City Iron Wks., Erie, Pa.
Hartley Blr. Wks., Montgomery, Ala.
Heine Boiler Co., St. Louis, Mo.
E. Keeler Co., Williamsport, Pa.
Geo. T. Ladd Co., Pittsburgh, Pa.
V. Leffel & Co., Springfield, O.
Lord & Burnham Co., Irvington, N.Y.
Murray Iron Wks. Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Wks. Co., Sharon, Pa.
Schofield Iron Wks., Macon, Ga.
Stanwood Corp., Cincinnati, O.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Valk & Murdock Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Blr. Co., Chattanooga, Tenn.

BRACES, TRENCH
Jas. H. Channon Mfg. Co., Chicago.
Duff Mfg. Co., Pittsburgh, Pa.
Kalamazoo Fdry. & Mach. Co., Kalamazoo, Mich.
Waldo Bros. & Bond Co., Boston.

BRANDING TOOLS
*Everhot Mfg. Co., Maywood, Ill.

BRASS GOODS
*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Hays Mfg. Co., Erie, Pa.
Mueller Company, Decatur, Ill.
United Brass Mfg. Co., Cleveland, O.

BREAKERS, CONCRETE
*Buckeye Trac. Ditcher Co., Findlay, O.
*Ingersoll-Rand Co., N. Y.
Chicago Pneumatic Tool Co., N. Y.
Cleveland Rock Drill Co., Cleveland, O.

BRICK, PAVING (See Paving Brick)

BRIDGES AND BUILDINGS, STEEL
*Blaw-Knox Co., Pittsburgh, Pa.
*Russell Grader Mfg. Co., Minneapolis.
*Frederick Snare Corporation, N. Y.
Amer. Bridge Co., N. Y.
Bellefontaine Br. & Stl. Co., Bellefontaine, O.
Belmont Iron Wks., Phila.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Boston Bridge Wks., Boston.
Central States Br. Co., Ind'polis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Ir. Wks., Baltimore, Md.
Chicago Br. & I. Wks., Chicago.
Clinton Bridge Wks., Clinton, Ia.
Eastern Bridge & Struc. Co., Worcester, Mass.
Flour City Orn. Iron Co., Minneapolis.
Fort Pitt Br. Wks., Pittsburgh, Pa.
Ingalls Ir. Wks. Co., Birmingham, Ala.
Inter. Stl. & Ir. Co., Evansville, Ind.
Louisville Br. & Ir. Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Br. Co., Milwaukee, Wis.
Minn. Stl. & Mchy. Co., Minneapolis.
Missouri Vy. Br. & Ir. Co., Leavenworth, Kan.
Morava Constr. Co., Chicago.
Mt. Vernon Br. Co., Mt. Vernon, O.
Penn. Bridge Co., Beaver Falls, Pa.
Pittsburgh-Des Moines Stl. Co., Pittsburgh, Pa.
Richmond Struc. Stl. Co., Richmond, Va.
Riverside Br. Co., Martins Ferry, O.
Virginia Br. & Ir. Co., Roanoke, Va.
Wisc. Br. & Ir. Co., No. Milwaukee, Wis.

BRONZE TABLETS
Flour City Orn. Ir. Co., Minneapolis.
Imperial Brass Mfg. Co., Chicago.
J. L. Mott Iron Wks., N. Y.

BROOMS (See Street Sweeping Brooms)

BUCKETS, AUTOMATIC DUMPING
*Lakewood Eng. Co., Cleveland, O.
*Littleford Bros., Cincinnati, O.
*G. L. Stuebner Ir. Wks., Inc., Long Island City, N. Y.
*Union Iron Wks., Inc., Hoboken, N. J.

BUCKETS, CLAM SHELL
*Blaw-Knox Co., Pittsburgh, Pa.
*Geo. Haiss Mfg. Co., N. Y.
*J. F. Kiesler Co., Chicago.
*Lakewood Eng. Co., Cleveland, O.
*Mead-Morrison Mfg. Co., E. Boston.
*Orton Crane & Shovel Co., Chicago
Brown Hoisting Mach. Co., Cleveland, O.
Browning Co., Cleveland, O.
F. A. Coleman Co., Cleveland, O.
Erie Steel Const'n Co., Erie, Pa.
Hayward Co., N. Y.
Industrial Wks., Bay City, Mich.
Link-Belt Co., Chicago.
McMyler Interstate Co., Cleveland, O.
Owen Bucket Co., Cleveland, O.
G. H. Williams Co., Erie, Pa.

BUCKETS, CONCRETE
*Insley Mfg. Co., Indianapolis, Ind.
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Lakewood Eng. Co., Cleveland, O.
*Ransome Conc. Mchy. Co., Dunellen, N. J.
*G. L. Stuebner Ir. Wks., Inc., Long Island City, N. Y.
*Union Iron Works, Inc., Hoboken, N. J.

BUCKETS, DRAGLINE
*Dobbie Fdry. & Mchy. Co., Niagara Falls, N. Y.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Pioneer Bucket Co., Indianapolis, Ind.
*Russel Grader Mfg. Co., Minneapolis.
*Sauerman Bros., Chicago.
Am. Mfg. & Eng. Co., Kalamazoo, Mich.
Page Eng. Co., Chicago.

BUCKETS, DREDGING AND EXCAVATING
*Blaw-Knox Co., Pittsburgh, Pa.
*Geo. Haiss Mfg. Co., N. Y.
*J. F. Kiesler Co., Chicago.
*Lakewood Eng. Co., Cleveland, O.
*Mead-Morrison Mfg. Co., E. Boston.
*Orton Crane & Shovel Co., Chicago
Brown Hoisting Mach. Co. Cleveland, O.
Browning Co., Cleveland, O.
Hayward Co., N. Y.
Owen Bucket Co., Cleveland, O.
G. H. Williams Co., Erie, Pa.

BUCKETS, ORANGE PEEL
*J. F. Kiesler Co., Chicago.
*Mead-Morrison Mfg. Co., E. Boston.
*Orton Crane & Shovel Co., Chicago
Hayward Co., N. Y.
Industrial Wks., Bay City, Mich.
McMyler Interstate Co., Cleveland, O.

BUILDINGS, STEEL (See Bridges)

BUNKS AND COTS
Ft. Pitt Bedding Co., Pittsburgh, Pa.
Haggard & Marcusson Co., Chicago.
Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS
*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Russell Grader Mfg. Co., Minneapolis.
*Sauerman Bros., Chicago.
*Street Bros. Mach. Wks., Chattanooga.
Broderick & Bascom Rope Co., St. Louis, Mo.
J. A. Roebling Sons Co., Trenton, N.J.
Waterbury Co., N. Y.

CABLEWAYS, SLACKLINE
*Russell Grader Mfg. Co., Minneapolis.
*Sauerman Bros., Chicago.
*Street Bros. Mach. Wks., Chattanooga

CAISSONS
American Bridge Co., N. Y.
Birmingham Tank Co., Bmingham, Ala.
Foundation Co., N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
O'Rourke Eng. Constr. Co., N. Y.
Petroleum Ir. Wks. Co., Sharon, Pa.

CALCIUM CHLORIDE FOR ROADS
*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., Syracuse, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

CANS FOR GARBAGE AND REFUSE
American Can Co., N. Y.
Butler Mfg. Co., Minneapolis.
Economy Baler Co., Ann Arbor, Mich.
Rochester Can Co., Rochester, N. Y.
Solar-Sturges Mfg. Co., Chicago.
Steel Basket Co., Cedar Rapids, Ia.

CARS, INDUSTRIAL V. DUMPING
*Easton Car & Const. Co., Easton, Pa.
*Insley Mfg. Co., Indianapolis, Ind.
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Lakewood Eng. Co., Cleveland, O.
*G. L. Stuebner Ir. Wks., Inc., Long Island City, N. Y.
Atlas Car & Mfg. Co., Cleveland, O.
Austin Mach. Corp., Muskegon, Mich.
Chase Fdry. & Mfg. Co., Columbus, O.
C. W. Hunt Co., W. New Brighton, N. Y.
United Ir. Wks., Inc., Kans. City, Mo.
Weller Mfg. Co., Chicago.
Whiting Corp., Harvey, Ill.

CARTS, CONCRETE
*Akron Barrow Co., Cleveland, O.
*Easton Car & Const. Co., Easton, Pa.
*Insley Mfg. Co., Indianapolis, Ind.
*Jackson Mfg. Co., Harrisburg, Pa.
*Lakewood Eng. Co., Cleveland, O.
*Lansing Co., Lansing, Mich.
*Littleford Bros., Cincinnati, O.
*Ransome Conc. Mchy. Co., Dunellen, N.J.
*T. L. Smith Co., Milwaukee.
*Sterling Wheelbarrow Co., Milwaukee.
*Toledo Wheelbarrow Co., Toledo, O.
Chattanooga Wheelbarrow Co., Chattanooga, Tenn.
Cleveland Wheelbarrow Co., Cleveland, O.
E. D. Etnyre & Co., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Lee Trailer & Body Co., Chicago.

CAST IRON PIPE (See Pipe, Cast Iron)

CASTINGS, STREET AND SEWER
*Burch Plow Wks. Co., Crestline, O.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*U. S. Cast Ir. Pipe & Fdry. Co., Burlington, N. J.

Two of the Valerio Construction Co.'s four ERIES on a 225,000 cu. yd. road cut, averaging 500 cu. yds. per shovel in this hard shale, without blasting.

"The Salesman asked me if I had done any blasting, and when I said 'NO'---

—"he didn't say another word," writes Mr. Valerio; "When a salesman comes on the job to sell me another make of shovel, I tell him all right, I'll buy the shovel if it will dig this shale like the ERIE does.

"Give me the ERIE Shovel for satisfactory work. It is a good reliable piece of machinery with very small upkeep—much better than any other shovel on the market today."—F. Valerio, President, Valerio Construction Co., New Milford, Conn. (4 ERIES).

He speaks for ***thousands***

A dozen or two of letters like this would make you think— but thousands of such reports from contractors are ***convincing.***

One letter after another tells how ERIES do harder work, and stand up much better in the ordinary run of digging.

It is service like this that has made ERIES

The largest selling revolving shovels and cranes—because the *most reliable.*

More than 3,700 ERIES now in service. This unique experience in shovel building is your assurance of a ***sound*** machine.

No radical changes have ever marked the ERIE'S development — just a constant improvement in a machine that was always basically right.

Have you seen the B-2 ERIE "Dreadnaught?" Handles a 1 yd. dipper and stands up to it splendidly— but is as compact as many ¾ cu. yd. machines. You will size it up as the finest steam shovel you have ever seen— write for description.

ERIE STEAM SHOVEL CO., Erie, Pa., U. S. A.

Builders of ERIE Shovels, Cranes, Draglines, etc.
Branch Offices: Boston, New York, Philadelphia, Pittsburgh, Atlanta, Chicago
Representatives throughout the U. S. A.

ERIE Revolving Shovels

Canton Fdry. & Mach. Co., Canton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Central Fdry. Co., N. Y.
J. B. Clow & Sons, Chicago.
W. E. Dee Co., Chicago.
Elkhart Fdry. & Mach. Co., Elkhart, Ind.
Foundry Mfg. Co., St. Albans, Vt.
Gilbert Mfg. Co., Aberdeen, S. Dak.
Klauer Mfg. Co., Dubuque, Ia.
Madison Fdry. Co., Cleveland, O.
Pechstein Iron Works, Keokuk, Ia.
Portable Mach. Co., Passaic, N. J.
Sessions Foundry Co., Bristol, Conn.
South Bend Fdry. Co., So. Bend, Ind.

CATCH BASINS (See Castings, Street)

CATCH BASIN CLEANING OUTFITS
*Mack Trucks, Inc., N. Y.
Elgin Sales Corp., N. Y.
Movakan Co., Indianapolis, Ind.

CAULKING MACHINERY AND TOOLS
*Ingersoll-Rand Co., N. Y.
Helwig Mfg. Co., St. Paul, Minn.
Mueller Company, Decatur, Ill.

CEILINGS, METAL
Berger Mfg. Co., Canton, O.
Canton Art Metal Co., Canton, O.
Globe Iron Roofing & Cor. Co., Cincinnati, O.
Newport Rolling Mill Co., Newport, Ky.
Klauer Mfg. Co., Dubuque, Ia.
Geo. L. Mesker & Co., Evansville, Ind.
Milwaukee Corr. Co., Milwaukee.
Wheeling Corr. Co., Wheeling, W. Va.

CEMENT (*P. C. stands for Portland Cement*)
*Pennsylvania Cement Co., N. Y.
Acme Cement Corp., Catskill, N. Y.
Ætna P. C. Co., Detroit, Mich.
Alabama P. C. Co., Birmingham, Ala.
Allentown P. C. Co., Allentown, Pa.
Alpha P. C. Co., Easton, Pa.
Ash Grove Lime and P. C. Co., Kansas City, Mo.
Atlas P. C. Co., N. Y.
Beaver P. C. Co., Portland, Ore.
Bessemer Limestone & C. Co., Youngstown, O.
British Col. Cement Co., Victoria, B. C.
Canada Cement Co., Ltd., Montreal, Canada.
Clinchfield P.C. Corp., Kingsport, Tenn.
Colorado P. C. Co., Denver, Colo.
Cowell P. C. Co., Cowell, Cal.
Crescent P. C. Co., Wampum, Pa.
Dewey P. C. Co., Kansas City, Mo.
Dexter P. C. Co., Nazareth, Pa.
Diamond P. C. Co., Cleveland, O.
Dixie P. C. Co., Chattanooga, Tenn.
Edison P. C. Co., N. Y.
Georgia Cement & Stone Co., Birmingham, Ala.
Giant P. C. Co., Philadelphia, Pa.
Glens Falls P.C. Co., Glens Falls, N.Y.
Golden State P.C. Co., Los Angeles, Cal.
Great West'n P. C. Co., Kans. C., Mo.
Hawkeye P. C. Co., Des Moines, Ia.
Hercules Cement Corp., Philadelphia.
Hermitage P. C. Co., Nashville, Tenn.
Huron P. C. Co., Detroit, Mich.
Indiana P. C. Co., Indianapolis, Ind.
International Cement Corp., N. Y.
International P. C. Co., Ltd., Spokane, Wash.
Kansas P. C. Co., Kansas City, Mo.
Knickerbocker P. C. Co., Inc., N. Y.
Kosmos P. C. Co., Louisville, Ky.
La Tolteca Compania de Cemento Portland, Mexico City, Mex.
Lawrence P. C. Co., Northampton, Pa.
Lehigh P. C. Co., Allentown, Pa.
Louisville Cement Co., Louisville, Ky.
Manitowoc P. C. Co., Manitowoc, Wis.
Marlboro Cement Co., Edmonton, Can.
Marquette Cement Mfg. Co., Chicago.
Missouri P. C. Co., St. Louis, Mo.
Monarch Cement Co., Humboldt, Kans.
Monolith P. C. Co., Los Angeles, Cal.
National Cement Co., Birmingham, Ala.
Nazareth Cement Co., Nazareth, Pa.
Nebraska Cement Co., Denver, Colo.
Newago P. C. Co., Newago, Mich.
New Egyptian P. C. Co., Detroit.
North Amer. Cement Corp., Albany.
Northwestern States P. C. Co., Mason City, Ia.
Oklahoma P. C. Co., Denver.
Olympic P. C. Co., Ltd., Seattle.
Oregon P. C. Co., Portland, Ore.
Pacific P. C. Co., San Francisco.
Peerless P. C. Co., Union City, Mich.
Peninsular P. C. Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey P. C. Co., Petoskey, Mich.
Phoenix P. C. Co., Nazareth, Pa.
Pgh. Plate Glass Co., Pittsburgh, Pa.
P. C. Co. of Utah, Salt Lake City.
Pyramid P. C. Co., Des Moines
Riverside P. C. Co., Los Angeles.
St. Marys Cement Co., Toronto, Can.
San Antonio P. C. Co., San Antonio.
Sandusky Cement Co., Cleveland, O.
Santa Cruz P. C. Co., San Francisco.
Signal Mountain P. C. Co., Chatta., Tenn.
Southern States P. C. Co., Rockport, Ga.
Southwest'n P. C. Co., El Paso, Tex.
Sun P. C. Co., Portland, Ore.
Superior P. C. Co., Seattle, Wash.
Texas P. C. Co., Dallas, Tex.
Three Forks P. C. Co., Denver, Colo.
Tidewater P. C. Co., Baltimore, Md.
Trinity P. C. Co., Dallas, Tex.
Union P. C. Co., Ogden, Utah
U. S. P. C. Co., Denver, Colo.
Universal P. C. Co., Chicago
Utah Idaho Cement Co., Ogden, Utah
Vulcanite P. C. Co., Philadelphia
Wabash P. C. Co., Detroit
Wolverine P. C. Co., Coldwater, Mich.
Wyandotte P. C. Co., Detroit

CEMENT BLOCK MACHINES
*Cement Block Mach. Co., Newark, N. J.

CEMENT GUNS
Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CEMENT TOOLS
*Abrams Cement Tool Co., Detroit

CENTRIFUGAL PUMPS (See "Pumps, Centrifugal")

CHAINS
Amer. Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago
Weller Mfg. Co., Chicago

CHIMNEYS, CONCRETE
Heine Chimney Co., Chicago
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago

CHIMNEYS, RADIAL BRICK
Amer. Chimney Corp., N. Y.
Alphons Custodis Chimney Const. Co. N.Y.
Continental Chimney Co. of Chi., Chicago
Heine Chimney Co., Chicago
H. R. Heinicke, Inc., Indianapolis, Ind.
M. W. Kellogg & Co., N. Y.
Rust Eng. Co., Pittsburgh, Pa.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS
*Wallace & Tiernan Co., Inc., Newark, N. J.

CHLORINE, LIQUID
(See Liquid Chlorine)

CHUTES, CONCRETE
*Insley Mfg. Co., Indianapolis, Ind.
*Lakewood Eng. Co., Cleveland, O.
*Ransome Conc. Mchy. Co., Dunellen, N.J.

CLIPS, WIRE ROPE
Amer. Hoist & Derrick Co., St. Paul, Minn.
Fischer & Hayes Rope & Steel Co., Chicago
Marion Malleable Ir. Wks., Marion, Ind.
C. M. Mockbee & Co., Cincinnati, O.
John A. Roebling Sons Co., Trenton, N.J.
Upson-Walton Co., Cleveland, O.

CLUTCHES
*Twin Disc Clutch Co., Racine, Wis.
*Waukesha Motor Co., Waukesha, Wis.

COAL AND ORE CONVEYING MCHY.
*Barber-Greene Co., Aurora, Ill.
*Good Roads Machy. Co., Kennett Sq., Pa.
*Chicago Automatic Conv. Co., Chicago
*Fairfield Eng. Co., Marion, O.
*Geo. Haiss Mfg. Co., N. Y.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
C. O. Bartlett & Snow Co., Cleveland, O.
Brown Hoisting Mchy. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson N. Y.
C. W. Hunt Co., Inc., W. New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Kon-Wald Co., Buffalo, N. Y.
Link-Belt Co., Chicago.
Morrow Mfg. Co., Wellston, Ohio.
Portable Machinery Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y.
Webster Mfg. Co., Chicago
Weller Mfg. Co., Chicago.

COCKS, CURB AND CORPORATION
*Union Wtr. Mtr. Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Hays Mfg. Co., Erie, Pa.
Mueller Co., Decatur, Ill.

COLLAPSIBLE HORSES
*Taylor Collapsible Horse Co., Chicago.

COLUMN CLAMPS
*Insley Mfg. Co., Indianapolis, Ind.
*M. & M. Wire Clamp Co., Minneapolis
The O. D. G. Co., Owensboro, Ky.
Victor L. Phillips Co., Kansas City, Mo.
Sterling Wheelbarrow Co., Milwaukee.
Symons Clamp & Mfg. Co., Chicago.
Universal Form Clamp Co., Chicago

COMPRESSORS, AIR (See Air Compressors)

CONCRETE BLOCK MACHINES (See Cement Block Machines)

CONCRETE FLOOR HARDENER
Anti-Hydro Waterproofing Co., Newark, N. J.

General Chemical Co., N. Y.
General Firepr. Co., Youngstown, O.
Granitex Corp., N. Y.
A. C. Horn Co., L. I. City, N. Y.
Master Builders Co., Cleveland, O.
L. Sonneborn Sons, Inc., N. Y.
Truscon Laboratories, Detroit.

CONCRETE HEATERS
*Aeroil Burner Co., Union Hill, N. J.
*Chausse Oil Burner Co., Elkhart, Ind.
*Hauck Mfg. Co., Brooklyn, N. Y.
*Alex. Milburn Co., Baltimore, Md.

CONCRETE MIXERS
*Amer. Cem. Mchy. Co., Inc., Keokuk, Ia.
*Atlas Eng. Co., Milwaukee, Wis.
*Construction Mchy. Co., Waterloo, Ia.
*Foote Conc. Mchy. Co., Chicago
*Jaeger Mach. Co., Columbus, O.
*Kiel Mixer Co., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Kwik-Mix Con. Mixer Co., Port Washington, Wis.
*Lakewood Eng. Co., Cleveland, O.
*Lansing Co., Lansing, Mich.
*Raber & Lang Mfg. Co., Kendallville, Ind.
*Ransome Con. Mchy. Co., Dunellen, N.J.
*Schramm, Inc., West Chester, Pa.
*T. L. Smith Co., Milwaukee, Wis.
*Standard Scale & Supply Co., Pittsburgh
Anchor Mfg. Co., Chicago.
Badger Con. Mixer Co, Milwaukee
Chain Belt Co., Milwaukee
Contractors' Equip. Co., Keokuk, Ia.
B. M. Cropp Co., Chicago.
The Foote Co., Nunda, N. Y.
Gray Iron Fdry Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Leach Co., Oshkosh, Wis.
Marsh-Capron Co., Chicago.
Milwaukee Conc. Mixer Co., Milwaukee.
Remmel Mfg. Co., Kewaskum, Wis.
Republic Ir. Wks. Tecumseh, Mich.
Truckmixer Co., Milwaukee.

CONCRETE PILING (See Piling)

CONCRETE PIPE (See Pipe, Concrete)

CONCRETE REINFORCEMENT
*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., N. Y.
Consolidated Exp. Metal Co., Braddock, Pa.
Electric Welding Co., Pittsburgh, Pa.
Ft. Pitt Bridge Wks, Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago.
Kalman Steel Co., Chicago.
Laclede Steel Co., St. Louis, Mo.
National Steel Fabric Co., Pittsburgh.
J. T. Ryerson & Son, Chicago.
Wickwire-Spencer Steel Co., N. Y.
Youngstown Pressed Steel Co., Warren, O.
Youngstown Sheet & Tube Co., Youngstown, O.

CONCRETE ROAD FINISHERS
*Heltzel Stl. Form & Iron Co., Warren, O.
*Lakewood Eng. Co., Cleveland, O.
Dunn Road Mach. Co., Conneaut, O.
A. W. French & Co., Chicago

CONCRETE SURFACING MACHINES
*Concrete Surfacing Machy. Corp., Cincinnati, O.
W. H. Keller, Inc., Grand Haven, Mich.

CONCRETE TOOLS
*The Dallett Co., Philadelphia.

CONDENSERS
*Ingersoll-Rand Co., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee.
Dean Bros. Co., Indianapolis, Ind.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wheeler Cond. & Eng. Co., Carteret, N.J.
Worthington Pump & Machy Corp., N.Y.

CONDUIT RODS
F. Bissell Co., Toledo, O.
Turbine Sewer Mch. Co., Milwaukee.
Waldo Bros. & Bond Co., Boston.

CONDUITS, UNDERGROUND
Amer. Vitr. Products Co., Akron, O.
Johns-Manville Inc., N. Y.
National Fireproofing Co., N. Y.
Rie-wiL Co., Cleveland.

CONTRACTORS' EQUIPMENT DEALERS (See pages 167 to 183)

CONVEYORS, BELT
*Austin-Western Rd. Mchy, Co., Chicago
*Barber-Greene Co., Aurora, Ill.
*Chicago Automatic Conv. Co., Chicago
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Rds. Mchy. Co., Kennett Sq., Pa.
*Geo. Haiss Mfg. Co., N. Y.
*Russell Grader Mfg. Co., Minneapolis.
Brown Hoisting Machy. Co., Cleveland
Chain Belt Co., Milwaukee.
Gifford Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago.
Samuel Olson & Co., Chicago.
Portable Machy Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y.
Standard Conv. Co., No. St. Paul, Minn.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.

CONVEYORS, BUCKET
*Atlas Eng. Co., Milwaukee.
*Chicago Automatic Conv. Co., Chicago
*Fairfield Eng. Co., Marion, O.
*Good Rds. Machy. Co., Kennett Sq., Pa.
*Geo. Haiss Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Russell Grader Mfg. Co., Minneapolis.
C. O. Bartlet & Snow Co., Cleveland, O.
Brown Hoisting Machy. Co., Cleveland, O.
H. W. Caldwell & Son, Chicago.
Chain Belt Co., Milwaukee.
Gifford Wood Co., Hudson, N. Y.
Godfrey Conv. Co., Elkhart, Ind.
Guarantee Constn. Co., N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago.
Samuel Olson & Co., Chicago.
Republic Rubber Co., Youngstown, O.
Robins Conv. Belt Co., N. Y.
Stephens Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.

CONVEYORS, GRAVITY
Lamson Co., Syracuse, N. Y.
Logan Co., Louisville, Ky.
Mathews Gravity Carrier Co., Elwood City, Pa.
Standard Conv. Co., No. St. Paul, Minn.

COUPLINGS, HOSE
*Ingersoll-Rand Co., N. Y.
Cleveland Pneum. Tool Co., Cleveland, O.
Gilman Mfg. Co., East Boston, Mass.
W. H. Keller, Inc., Grand Haven, Mich.

CRANES, LOCOMOTIVE
*Bay City Dredge Wks., Bay City, Mich.
*Byers Machine Co., Ravenna, O.
*Erie Steam Shovel Co., Erie, Pa.
*Harnischfeger Corp., Milwaukee.
*Koehring Co., Milwaukee.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
Amer. Hst. & Derrick Co., St. Paul, Minn.
Brown Hoisting Machy Co., Cleveland.
Browning Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Davenport Loc. Wks., Davenport, Ia.
Hanna Eng. Works, Chicago.
Industrial Wks., Bay City, Mich.
Link-Belt Co., Chicago.
Loc. Crane Co. of Amer., Champaign, Ill.
McMyler Interstate Co., Cleveland, O.
Northwest Eng. Works, Chicago.
Ohio Loc. Crane Co., Bucyrus, O.
Thew Shovel Co., Lorain, O.
U. S. Crane Co., Chicago.

CRANES, OVERHEAD TRAVELING
*Curtis Pneum. Mach. Co., St. Louis
*Harnischfeger Corp., Milwaukee.
Alliance Mach. Co., Alliance, O.
Chesapeake Iron Wks., Baltimore, Md.
Chisholm-Moore Mfg. Co., Cleveland, O.
Milwaukee Elec. Crane Co., Milwaukee.
Morgan Eng. Co., Alliance, O.
Northern Eng. Wks., Detroit, Mich.
Shaw Crane Wks., Muskegon, Mich.
Shepard Elec. Cr. & Hst. Co., Montour Falls, N. Y.
Toledo Crane Co., Bucyrus, O.
Whiting Fdry. & Equip. Co., Harvey, Ill.

CRANES, TRUCK
*Byers Machine Co., Ravenna, O.
*Harnischfeger Corp., Milwaukee.
*Orton Crane & Shovel Co., Chicago
Bay City Fdry. & Mach. Co., Bay City, Mich.
Universal Crane Co., Cleveland.

CRANES, WRECKING
Bucyrus Co., So. Milwaukee, Wis.
Industrial Wks., Bay City, Mich.

CRAWLER ATTACHMENTS
Geo. Haiss Mfg. Co., New York

CREOSOTED BLOCKS, TIMBER, ETC.
Amer. Creos. Co., Inc., Louisville, Ky.
Amer. Creos. Wks., Inc., N. Orleans, La.
Carter Bloxonend Flooring Co., K. City, Mo.
Colonial Cre. Co., Inc., Louisville, Ky.
Creos. Materials Co., N. Orleans, La.
Georgia Creos. Co., Louisville, Ky.
Jennison-Wright Co., Toledo, O.
Midland Creos. Co., Granite City, Ill.
Republic Creos. Co., Indianapolis, Ind.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creos. Co., N. Y.

CREOSOTING AND CREOSOTING OILS
*Barrett Co., N. Y.
Amer. Creos. Wks., Inc., N. Orleans, La.
Amer. Tar Prod. Co., Pittsburgh, Pa.
Jennison-Wright Co., Toledo, O.
Southern Creos. Co., Ltd., Slidell, La.
Southern Pavg. Const. Co., Chattanooga.
Wyckoff Pipe & Creos. Co., N. Y.

CRUSHERS, HEAVY DUTY
Allis-Chalmers Mfg. Co., Milwaukee.
O. G. Buchanan Co., N. Y.
Traylor Eng. & Mfg. Co., Allentown, Pa.

CRUSHERS, ROCK
*Acme Rd. Machy. Co., Frankfort, N. Y.
*Austin-Western Rd. Mach. Co., Chicago
*Galion Iron Wks. & Mfg. Co., Galion, O.
*Good Rds. Machy. Co., Kennett Sq., Pa.
*Russell Grader Mfg. Co., Minneapolis.
*Smith Eng. Wks., Milwaukee.
*Universal Rd Machy Co., Kingston, N.Y.
Morgan Eng. Co., Alliance, O.
New Holland Mach. Co., New Holland, Pa.
Sturtevant Mill Co., Boston.
Universal Crusher Co., Cedar Rapids, Ia.

CULVERTS, CAST IRON
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
Amer. C. I. Pipe Co., Birmingham, Ala.
Gilbert Mfg. Co., Aberdeen, S. D.
R. D. Wood & Co., Philadelphia

CULVERTS, CORRUGATED METAL
*Austin-Western Rd. Mach. Co., Chicago
*Galion Iron Wks. & Mfg. Co., Galion, O.
*Good Rds. Mach. Co., Kennett Sq., Pa.
*Newport Culvert Co., Newport, Ky.
Bark River Bridge & Culv. Co., Bark River, Mich.
Boardman Co., Okla. City, Okla.
Burnham Mfg. Co., Woods Cross, Utah.
Calif. Corr. Culv. Co., W. Berkeley, Cal.
Canada Ingot Ir. Co., Ltd., Guelph, Ont.

Canton Culv. & Silo Co., Canton, O.
Coast Culv. & Flume Co., Portland, Ore.
Corr. Culv. Co., Moberly, Mo.
Dixie Culv. & Metal Co., Atlanta, Ga.
Dixie Culv. Mfg. Co., Little Rock, Ark.
Fla. Metal Prod. Co., Jacksonville, Fla.
Gilbert Mfg. Co., Aberdeen, S. D.
R. Hardesty Mfg. Co., Denver, Colo.
Highway Prod. & Mfg. Co., Elmira, N.Y.
Ind. Corr. Culv. Co., Mason City, Ia.
Iowa Pure Ir. Co., Des Moines, Ia.
Klauer Mfg. Co., Dubuque, Ia.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Md. Culv. & Metal Co., Baltimore.
N. E. Metal Culv. Co., Palmer, Mass.
Nebraska Culv. & Mfg. Co., Wahoo, Neb.
North East Metal Culv. Co. Nashua, N.H.
Northfield Ir. Co., Northfield, Minn.
Northw't'rn Sheet & Ir. Wks., Wahpeton, N. D.
Ohio Corr. Culv. Co., Middletown, O.
W. Q. O'Neall Co., Crawfordsville, Ind.
Road Supply & Metal Co., Topeka, Kan.
Sioux Falls Metal Culv. Co., Sioux Falls, S. D.
So. Metal Culv. Co., Salisbury, N. C.
Spokane Culv. & Tank Co., Spokane.
Tenn. Metal Culv. Co., Nashville.
U. S. Br. & Culv. Co., Bay City, Mich.
Va. Metal Mfg. Co., Roanoke, Va.
Western Metal Mfg. Co., Houston, Tex.
Wheeling Corr. Co., Wheeling, W. Va.
Wyatt Metal & Blr. Wks., Dallas, Tex.

CULVERT FORMS
Concrete Form Co., Inc., Syracuse, N.Y.
Northfield Iron Co., Northfield, Minn.

CURB BOXES
Casey-Hedges Co., Chattanooga, Tenn.
H. W. Clark Co., Mattoon, Ill.
J. B. Clow & Sons, Chicago.
Madison Fdry. Co., Cleveland, O.
Mueller Co., Decatur, Ill.

CURB GUARDS, STEEL
*W. S. Godwin Co., Baltimore.

CURB, STEEL PROTECTED
*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., N. Y.

CURING OF CONCRETE
*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., N. Y.

CUTTERS, PIPE, HAND
Armstrong Mfg. Co., Bridgeport, Ct.
Barnes Tool Co., New Haven, Ct.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Oswego Tool Co., Oswego, N. Y.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston.

CUTTERS, ROD AND WIRE
*Koehring Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Carolus Mfg. Co., Sterling, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Worthington Pump & Mchy Corp., N.Y.

CUTTING EDGES
*Russell Grader Mfg. Co., Minneapolis
J. D. Adams & Co., Indianapolis, Ind.
Shunk Mfg. Co., Bucyrus, O.

CUTTING AND WELDING APPARATUS
*Alex. Milburn Co., Baltimore.
MacLeod Co., Cincinnati, O.

DERRICKS, GUY AND STIFF-LEG
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*S. Flory Mfg. Co., Bangor, Pa.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Mfg. Co., N. Y.
*Sasgen Derrick Co., Chicago.
*Street Bros. Mach. Wks., Chattanooga
*Universal Hstg. Machy Corp., Buffalo.
Amer. Hst. & Derrick Co., St. Paul, Minn.
Federal Br. & Struc. Co., Waukesha, Wis.
John T. Horton Co., N. Y.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
National Hstg. Eng. Co., Harrison, N.J.
Superior Iron Wks., Superior, Wis.

DERRICKS, PIPE LAYING
*Dobbie Fdry. & Mach. Co., Niagara Falls
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Wks., Chattanooga
Mueller Co., Decatur, Ill.
Squier-Rix Co., Milwaukee.

DERRICKS, REVOLVING
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Wks., Chattanooga

DERRICKS, STEEL
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Wks., Chattanooga
Amer. Hst. & Derrick Co., St. Paul
Hayward Co., N. Y.
Lakeside Bri. & St. Co., N. Milwaukee
Taylor Port. St. Derrick Co., Chicago.

DERRICKS, STEEL PORTABLE
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls.
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Wks., Chattanooga
Amer. Hst. & Derrick Co., St. Paul

DERRICKS, TRAVELING
*Bay City Dredge Wks., Bay City, Mich.
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls,
*Orton Crane & Shovel Co., Chicago
*Street Bros. Mach. Wks., Chattanooga
Amer. Hst. & Derrick Co., St. Paul
Austin Machy Corp., Muskegon, Mich.
Hayward Co., N. Y.
Nat'l Hstg. Eng. Co., Harrison, N. J.

DERRICK FITTINGS
*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Wks., Chattanooga

DIESEL ENGINES (See Engines, Oil)

DISTRIBUTORS, TAR AND ASPHALT
Kinney Mfg. Co., Boston

DISTRIBUTING PLANTS, CONCRETE
*Lakewood Eng. Co., Cleveland.
*Insley Mfg. Co., Indianapolis, Ind.
*Ransome Conc. Mchy. Co., Dunellen, N.J.
Archer Iron Works, Chicago.

DITCHING MACHINES (See Excavators)

DIVIDING PLATES (ROAD)
*W. S. Godwin Co., Baltimore

DOORS AND SHUTTERS, STEEL ROLLING
Cornell Iron Wks., Inc., N. Y.
Kinnear Mfg. Co., Columbus, O.
Variety Fire Door Co., Chicago.
J. G. Wilson Corp., N. Y.

DRAFTING MACHINES
Univ. Drafting Mach. Co., Cleveland, O.

DREDGES
*Bay City Dredge Wks., Bay City, Mich.
*Erie Steam Shovel Co., Erie, Pa.
*Lidgerwood Mfg. Co., N. Y.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
*Street Bros. Mach. Wks., Chattanooga
Amer. Steel Dredge Co., Ft. Wayne, Ind.
Street Bros. Mach. Wks., Chattanooga.
Bucyrus Co., So. Milwaukee, Wis.
Ellicott Machy Corp., Baltimore.
Hayward Co., N. Y.
Osgood Co., Marion O.
Stockton Iron Wks., Stockton, Cal.
Superior Iron Wks., Superior, Wis.

DREDGES, DIPPER
*Bay City Dredge Wks., Bay City, Mich.
*Marion Steam Shovel Co., Marion, O.
Amer. Steel Dredge Co., Ft. Wayne, Ind.
Austin Machy Corp., Muskegon, Mich.
Bucyrus Co., So. Milwaukee, Wis.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC
*Marion Steam Shovel Co., Marion, O.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore.
Morris Mach. Wks., Baldwinsville, N.Y.

DREDGING MACHINERY
*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Wks., Chattanooga

DREDGING PUMPS AND ACCESSORIES
Erie Pump & Engine Wks., Medina, N.Y.

DRILLS, CORE
*Ingersoll-Rand Co., N. Y.
*McKiernan-Terry Drill Co., N. Y.
*Sullivan Machy. Co., Chicago.
Dobbins Core Drill Co., Inc., N. Y.
Standard Diamond Drill Co., Chicago.

DRILLS, ROCK
*Dallett Co., Philadelphia.
*Denver Rock Drill Mfg. Co., Denver.
*Ingersoll-Rand Co., N. Y.
*McKiernan-Terry Drill Co., N. Y.
*Sullivan Machy. Co., Chicago.
Chicago Pneum. Tool Co., N. Y.
Cleveland Pneum. Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Gilman Mfg. Co., E. Boston.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneum. Tool Co., Chicago.
W. H. Keller, Inc., Grand Haven, Mich.
Wood Drill Wks., Paterson, N. J.

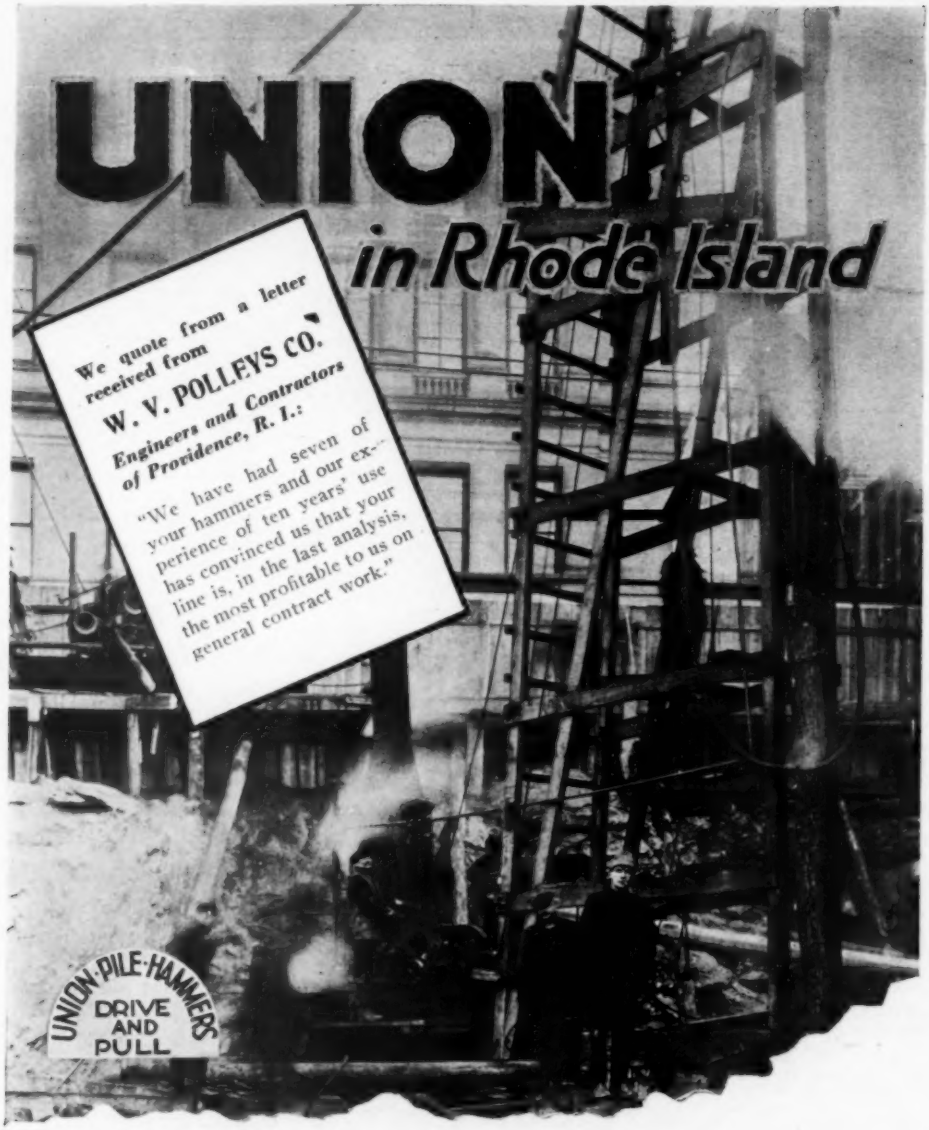
DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machy)

DRUMS, HOLDING
*Blaw-Knox Co., Pittsburgh, Pa.
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mch. Co., Niagara Falls.
*Street Bros. Mach. Wks., Chattanooga
Hayward Co., N. Y.
Monighan Machine Co., Chicago.

DRYERS, ASPHALT AND CEMENT
Allis-Chalmers Mfg. Co., Milwaukee.
Amer. Blower Co., Detroit, Mich.
Amer. Process Co., N. Y.
Atlas Dryer Co., Cleveland, O.
C. O. Bartlett & Snow Co., Cleveland, O.
F. D. Cummer & Son Co., Cleveland, O.
Ruggles-Coles Eng. Co., N. Y.

DRYERS, SAND AND GRAVEL
*Aeroil Burner Co., Union Hill, N. J.
*Chausse Oil Burner Co., Elkhart, Ind.
*Littleford Bros., Cincinnati, O.
*Alex. Milburn Co., Baltimore, Md.
C. O. Bartlett & Snow Co., Cleveland, O.
Chase & Lyman, Boston.

DUMP BODIES FOR MOTOR TRUCKS
*Anthony Co., Streator, Ill.
*Easton Car & Constn Co., Easton, Pa.
*Heil Co., Milwaukee.
*Insley Mfg. Co., Indianapolis, Ind.
*Littleford Bros., Cincinnati, O.
*Mack Trucks, Inc., N. Y.
*Marion Steel Body Co., Marion, O.
*N. Y. Central Ir. Wks., Hagerstown, Md.
*Superior Body Corpn., Marion, Ind.
*Stewart Iron Wks. Co., Cincinnati.
*Wood Hydr. Hoist & Body Co., Detroit
Am. Truck & Body Co., Martinsville, Va.
Archer Iron Wks., Chicago.
Columbia Body Corp., Columbia, Pa.
Columbian St. Tank Co., Kansas City.
Detroit Trailer & Mach. Co., Detroit.
Ditwiler Mfg. Co., Galion, O.



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Builders of Double Acting Pile Hammers Since 1906

NEWARK and MONROE STS. **HOBOKEN, NEW JERSEY**

Galion All Steel Body Co., Galion, O.
Griscom-Russell Co., N. Y.
Herr Dump Car Mfg Co., Coatesville, Pa.
Hughes-Keenan Co., Mansfield, O.
The Hug Co., Highland, Ill.
Jennings Aut. Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago.
Mandt Body Co., Keokuk, Ia.
Pechstein Iron Wks., Keokuk, Ia.
Van Dorn Iron Wks., Cleveland.

DUMP CARTS AND WAGONS, HORSE
*Acme Rd. Machy. Co., Frankfort, N. Y.
*Austin-Western Rd Machy. Co., Chicago.
*Eagle Wagon Wks., Auburn, N. Y.
*La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
*Russell Grader Mfg. Co., Minneapolis.
*Watson Truck Corp., Canastota, N. Y.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago.
Bain Wagon Co., Kenosha, Wis.
Columbia Body Corp., Columbia, Pa.
Convertible Wagon-Trailers, Inc., Buffalo, N. Y.
Gilbert Mfg. Co., Aberdeen, S. D.
Hagy Wagon Co., Abingdon, Va.
G. H. Holzbog & Bro., Jeffersonville, Ind.
Little Red Wagon Co., Omaha, Neb.
Stockland Rd. Machy. Co., Minneapolis.
Streich Bros., Oshkosh, Wis.
Thornhill Wagon Co., Lynchburg, Va.
Western Wheeled Scraper Co., Aurora, Ill.

DUST LAYING (CALCIUM CHLORIDE)
*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., N. Y.
Carbondale Calcium Co., Carbondale, Pa.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE (See Sewage Ejectors)

ELECTRIC GENERATORS AND MOTORS
Louis Allis Co., Milwaukee.
Allis-Chalmers Mfg. Co., Milwaukee.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago
General Elec. Co., Schenectady, N. Y.
Ideal Elec. & Mfg. Co., Mansfield, O.
Lincoln Elec. Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Elec. Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis.
Western Elec. Co., N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRIC LAMPS
General Elec. Co., Schenectady, N. Y.
Westinghouse Lamp Co., N. Y.

ELECTRIC LIGHTING PLANTS
*Climax Eng. Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee.
Cushman Motor Wks., Lincoln, Neb.
Fairbanks, Morse & Co., Chicago
General Elec. Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Western Elec. Co., N. Y.

ELECTRIC TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee.
General Elec. Co., Schenectady, N. Y.
Kuhlman Elec. Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRIC WIRES (See Wire)

ELEVATORS, BUCKET
*Atlas Eng. Co., Milwaukee.
*Austin-Western Rd. Machy. Co., Chicago.
*Fairfield Eng. Co., Marion, O.
*Good Rds. Machy. Co., Kennett Sq., Pa.
*Geo. Haiss Mfg. Co., N. Y.
*Littleford Bros., Cincinnati.
*Russell Grader Mfg. Co., Minneapolis.
*Spears-Wells Machy. Co., Oakland, Cal.
*Univ. Rd. Machy. Co., Kingston, N. Y.
Austin Mfg. Co., Chicago.
C. O. Bartlett & Snow Co., Cleveland, O.
Brown Hstg. Machy. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago.
Samuel Olson & Co., Chicago.
Robins Conv. Belt Co., N. Y.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.
Worthington Pump & Mchy. Corp., N.Y.

ELEVATORS, PASSENGER, FREIGHT, ETC.
Am. Elev. & Mach. Co., Louisville, Ky.
Atlantic Elev. Co., Inc., Philadelphia.
Bay State Elev. Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, O.
Kaestner & Hecht Co., Chicago.
Llewellyn Ir. Wks., Los Angeles, Cal.
Montgomery Elev. Co., Moline, Ill.
Otis Elevator Co., N. Y.
C. Ridgway & Son Co., Coatesville, Pa.
A. B. See Elec. Elev. Co., N. Y.
Speidel Elev. Corp., Reading, Pa.
Warner Elev. Mfg. Co., Cincinnati.
Warsaw Elev. Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE
*Alamo Eng. Co., Hillsdale, Mich.
*Caterpillar Tr'tor Co., San Leandro, Cal.
*Climax Eng. Co., Clinton, Ia.
*Continental Motors Corp., Detroit
*Domestic Eng. & Pump Co., Shippensburg, Pa.
*Hercules Corpn., Evansville, Ind.
*Hercules Motors Corp., Canton, O.
*Hinckley Motors, Inc., Detroit
*Le Roi Co., Milwaukee.
*Nove Engine Co., Lansing, Mich.
*Stover Mfg. & Eng. Co., Freeport, Ill.
*Waukesha Motor Co., Waukesha, Wis.
Allis-Chalmers Mfg. Co., Milwaukee
Beaver Mfg. Co., Milwaukee, Wis.
Buda Co., Harvey, Ill.
C. H. & E. Mfg. Co., Milwaukee
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneum. Tool Co., N. Y.
Cook Motor Co., Delaware, O.
Cushman Motor Wks., Lincoln, Neb.
Evinrude Motor Co., Milwaukee.
Fairbanks, Morse & Co., Chicago.
Foos Gas Eng. Co., Springfield, O.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Ia.
John Lauson Mfg. Co., New Holstein, Wis.
Sanderson-Cyclone Drill Co., Orrville, O.
Sterling Eng. Co., Buffalo, N. Y.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wisconsin Motor Mfg. Co., Milwaukee.
Worthington Pump & Mchy. Corp., N.Y.

ENGINES, HOISTING (See Hoists)

ENGINES, KEROSENE
*Alamo Eng. Co., Hillsdale, Mich.
*Climax Eng. Co., Clinton, Ia.
*Stover Mfg. & Eng. Co., Freeport, Ill.
*Waukesha Motor Co., Waukesha, Wis.

ENGINES, OIL
DIESEL
*Hadfield-Penfield Steel Co., Bucyrus, O.
Allis-Chalmers Mfg. Co., Milwaukee
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis.
Fulton Iron Wks. Co., St. Louis.
McIntosh & Seymour Corp., Auburn, N.Y.
Nordberg Mfg. Co., Milwaukee.
St. Mary's Oil Eng Co., St. Charles, Mo.
Western Machy. Co., Los Angeles, Cal.
SEMI-DIESEL
*Ingersoll-Rand Co., N. Y.
*Stover Mfg. & Eng. Co., Freeport, Ill.
Anderson Fdry. & Mach. Co., Anderson, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneum. Tool Co., N. Y.
De La Vergne Mach. Co., N. Y.
Fairbanks, Morse & Co., Chicago.
Foos Gas Eng. Co., Springfield, O.
Lombard Gov. Co., Ashland, Mass.
Muncie Oil Eng. Co., Muncie, Ind.
New London Ship & Eng. Co., Groton, Ct.
Nordberg Mfg. Co., Milwaukee.
Taylor Mach. Co., Cleveland, O.
Weber Eng. Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., N.Y.

ENGINES, PUMPING
*Climax Eng. Co., Clinton, Ia.
*Stover Mfg. & Eng. Co., Freeport, Ill.
*Waukesha Motor Co., Waukesha, Wis.
Allis-Chalmers Mfg. Co., Milwaukee.
Cushman Motor Wks., Lincoln, Neb.
Hooven, Owens, Rentschler Co., Hamilton, O.
Murray Iron Wks., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee.
Worthington Pump & Mchy. Corp., N.Y.

ENGINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee.
Dake Eng. Co., Grand Haven, Mich.
Erie-Ball Eng. Co., Pittsburgh, Pa.
Filer-Stowell Co., Milwaukee.
Hardie-Tynes Mfg Co., Birmingham, Ala.
J. Leffel Co., Springfield, O.
Morris Mach. Wks., Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee.
B. F. Sturtevant Co., Hyde Park, Boston.
Vilter Mfg. Co., Milwaukee.

ENGINES, SWINGING
*Dake Eng. Co., Grand Haven, Mich.
*Lidgerwood Mfg. Co., N. Y

EXCAVATING MACHINERY (See Names Under Exc'tors, also Steam Shovels)

EXCAVATORS, CABLEWAY
*Amer. Mfg. & Eng Co, Kalamazoo, Mich.
*Lidgerwood Mfg. Co., N. Y.
*Street Bros. Mach. Co., Chattanooga
Bucyrus Co., So. Milwaukee, Wis.
Ersted Machy. Mfg. Co., Portland, Ore.

EXCAVATORS, DITCH AND TRENCH
*Barber-Greene Co., Aurora, Ill.
*Bay City Dredge Wks., Bay City, Mich.
*Buckeye Trac. Ditcher Co., Findlay, O.
*Byers Mach. Co., Ravenna, O.
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Erie Steam Shovel Co., Erie, Pa.
*Harnischfeger Corp., Milwaukee.
*Insley Mfg. Co., Indianapolis, Ind.
*Keystone Driller Co., Beaver Falls, Pa.
*Lidgerwood Mfg. Co., N. Y.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
*Russell Grader Mfg. Co., Minneapolis.
*Street Bros. Mach. Co., Chattanooga
American Hst. & Derrick Co., St. Paul.
Austin Mach. Corpn., Muskegon, Mich.
Brown Hstg. Machy. Co., Cleveland.
Bucyrus Co., So. Milwaukee, Wis.
Economy Exc. Co., Iowa Falls, Ia.
Ersted Machy. Mfg. Co., Portland, Ore.
Hayward Co., N. Y.
Monighan Mach. Co., Chicago.
Osgood Co., Marion, O.
Owensboro Ditcher & Grader Co., Owensboro, Ky.
Parsons Co., Newton, Ia.
Speder Machy. Corp., Fairfield, Ia.
C. T. Topping Machy. Co., Dayton, O.

EXCAVATORS, DRAG-LINE
*Bay City Dredge Wks., Bay City, Mich.
*Byers Mach. Co., Ravenna, O.
*Clyde Ir. Wks Sales Co., Duluth, Minn.
*Erie Steam Shovel Co., Erie, Pa.
*Galion Ir. Wks & Mfg. Co., Galion, O.
*Harnischfeger Corp., Milwaukee, Wis.
*Lidgerwood Mfg. Co., N. Y.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
*Russell Grader Mfg. Co., Minneapolis.

*Sauerman Bros., Chicago.
*T. L. Smith Co., Milwaukee, Wis.
*Street Bros. Mach. Co., Chattanooga
Austin Machy. Corp., Muskegon, Mich.
Brown Hstg. Machy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Economy Exc. Co., Iowa Falls, Ia.
Ersted Machy. Mfg. Co., Portland, Ore.
C. L. Gade Exc. Wks., Iowa Falls, Ia.
Galion Ir. Wks. & Mfg. Co, Galion, O.
Hayward Co., N. Y.
Industrial Wks., Bay City, Mich.
Link-Belt Co., Chicago.
Monighan Mach. Co., Chicago.
Osgood Co., Marion, O.
Speder Machy. Corp., Fairfield, Ia.
Thew Shovel Co., Lorain, O.

EXPANDED METAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Exp. Metal Co., Braddock, Pa.
Kalman Steel Co, Chicago.
Northwestern Exp. Metal Co., Chicago.
Youngstown Pressed St. Co., Warren, O.

EXPANSION JOINT MATERIAL
*Barber Asphalt Co., Philadelphia.
*Barrett Co., N. Y.
*Philip Carey Co., Cincinnati, O.
*Texas Co., N. Y.
*Truscon Steel Co., Youngstown, O.
Hoosier Asph. Co., Alexandria, Ind.
Pioneer Asph. Co., Lawrenceville, Ill.
Servicised Products Corp., Chicago
Waring-Underwood Co., Philadelphia.

EXPLOSIVES
*Hercules Powder Co., Wilmington, Del.
Atlas Powder Co., Wilmington, Del.
E. I. Du Pont de Nemours & Co., Wilmington, Del.
Giant Powder Co., S. Francisco, Cal.
Grasselli Powder Co., Cleveland, O.

FENCING
*Stewart Ir. Wks. Co., Cincinnati, O.
Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago.
Anchor Post Iron Works, N. Y.
Cyclone Fence Co., Waukegan, Ill.
Dwiggins Wire Fence Co., Anderson, Ind.
Frost-Superior Fence Co., Warren, O.
Ind. Steel & Wire Co., Muncie, Ind.
Interlocking Fence Co., Morton, Ill.
Keystone Stl. & Wire Co., Peoria, Ill.
Kokomo Stl. & Wire Co., Kokomo, Ind.
Nitselman Bros., Muncie, Ind.
Mich. Wire Fence Co., Adrian, Mich.
Page Stl. & Wire Prod. Corp., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Tex. Cyclone Fence Co., Ft. Worth, Tex.
Wickwire-Spencer Steel Co., N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

PILING EQUIPMENT STEEL
Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
Gen. Fireproofing Co., Youngstown, O.
Van Dorn Iron Wks., Cleveland, O.

FILTERS, OIL
S. F. Bowser & Co., Inc., Ft. Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER
Amer. Water Softener Co., Phila., Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago.
Norwood Eng. Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
W. B. Scaife & Sons, Pittsburgh, Pa.

FINISHING MACHINES, CONCRETE ROAD (See Concrete Road Finishers)

FIRE ALARM SYSTEMS
Gamewell Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS
*Union Water Meter Co., Worcester, Mass.
Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Colo.
Sterling Siren Fire Alarm Co., Rochester, N. Y.

FIRE APPARATUS, MOTOR
*Mack Trucks, Inc., N. Y.
Ahrens-Fox Fire Eng. Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Boyer Fire App. Co., Logansport, Ind.
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Foamite-Childs Corp., Utica, N. Y.
Hale Fire Pump Co., Conshohocken, Pa.
Northern Fire Apparatus Co., Minneapolis, Minn.
Peter Pirsch & Sons Co., Kenosha, Wis.
Prospect Fire Engine Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Eng. Co., Indianapolis, Ind.
Waterous Fire Eng. Wks., St. Paul, Minn.
White Co., Cleveland

FIRE EXTINGUISHERS, CHEMICAL
American-LaFrance Fire Eng. Co., Elmira, N. Y.
Buffalo Fire App. Corp., Buffalo, N.Y.
C. J. Cross Mfg. Co., Inc., N. Y.
Foamite-Childs Co., Utica, N. Y.
Pyrene Mfg. Co., Newark, N. J.

FIRE HOSE (See Hose, Fire)

FIREPROOF BUILDING MATERIAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Detroit Stl. Prod. Co., Detroit, Mich.
Gen. Fireproofing Co., Youngstown, O.
Kalman Steel Co., Chicago.
Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh.
U. S. Gypsum Co., Chicago.
Youngstown Pressed Steel Co., Warren, O.

FIRST AID EQUIPMENT
American-La France Fire Engine Co., Elmira, N. Y.

FITTINGS, ACID RESISTING
*Barber Asphalt Co., Philadelphia

FLEXIBLE JOINTS
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Central Foundry Co., N. Y.
Coldwell-Wilcox Co., Newburgh, N. Y.
Crane Co., Chicago.
United Lead Company, N. Y.

FLOORING, COMPOSITION
*Barber Asphalt Co., Phila., Pa.
*Barrett Co., N. Y.
Am. Mason Safety Tr. Co., Lowell, Mass.
Johns-Manville, Inc., N. Y.
Marino Decking & Sup. Co., Phila., Pa.
Franklyn R. Muller & Co., Waukegan, Ill.

FLOORS, WOOD BLOCK
*Barrett Co., N. Y.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Jennison-Wright Co., Toledo, O.
Midland Creos. Co., Toledo, O.
Republic Creos. Co., Indianapolis, Ind.
Sou. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creos. Co., N. Y.

FLUSH TANKS
*Pacific Flush Tank Co., Chicago & N.Y.

FLUSHERS, STREET (See Street Flushers and Sprinklers)

FORD AND FORDSON EQUIPMENT

AIR COMPRESSORS FOR FORDSONS
*Curtis Pneum. Mach. Co., St. Louis.
*Schramm, Inc., West Chester, Pa.

AIR COMPRESSORS FOR FORD TRUCKS
*Buhl Co., Chicago.
*Domestic Eng. & Pump Co., Shippensburg, Pa.
*Schramm, Inc., West Chester, Pa.

CONCRETE MIXERS ON FORD TRUCKS
*Amer. Cem. Mach. Co., Keokuk, Ia.
Archer Iron Wks., Chicago
Milwaukee Conc. Mixer Co., Milwaukee.

DUMP BODIES FOR FORD TRUCKS
*Eagle Wagon Wks., Auburn, N. Y.
*Easton Car & Const'n Co., Easton, Pa.
*Heil Co., Milwaukee, Wis.
*Herr Dump Body Mfg. Co., Coatesville, Pa.
*Marion Steel Body Co., Marion, O.
*N. Y. Cent. Iron Wks. Co., Inc., Hagerstown, Md.
*Stewart Iron Wks. Co., Cincinnati, O.
*Superior Body Corp., Marion, Ind.
*Wood Hydr. Hoist & Body Co., Detroit.
American Prod. & Trad. Co., Chicago.
Anthony Co., Streator, Ill.
Archer Iron Works, Chicago.
Columbian Stl. Tank Co., K. City, Mo.
Ditwiler Mfg. Co., Galion, O.
Galion All Steel Body Co., Galion, O.
Griscom-Russell, N. Y.
Hughes-Keenan Co., Mansfield, O.
Jennings Auto. Dump Body Co., Roanoke, Va.
Lee Trailer & Body Co., Chicago.
Mandt Co., Keokuk, Ia.
Martin-Parry Corp., York, Pa.
Pechstein Iron Works, Keokuk, Ia.
Thompson Mfg. Co., Williston, S. C.
Van Dorn Iron Wks., Cleveland, O.

FORD MOTOR PUMPER
*Am. Stm. Pump Co., Battle Creek, Mich.

FORD PLOWS
Roderick Lean Mfg. Co., Mansfield, O.

FORD REPLACEMENT UNITS (AXLES AND TRANMISSIONS)
*Fuller & Sons Mfg. Co., Kalamazoo.
*Hinckley Motors, Inc., Detroit, Mich.
*Waukesha Motor Co., Waukesha, Wis.
*Warford Corp., N. Y.
Ruckstell Sales & Mfg. Co., N. Y.

FORD SPECIAL BODIES
Standard Comm. Body Corp., B'klyn.

FORD TRUCK EXTENSION FRAMES
Swedish Crucible Steel Co., Detroit.

FORDSON DITCHING MACHINE
Chas. T. Topping, Dayton, O.

FORDSON HOISTS
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
Ersted Mach. Mfg. Co., Portland, Ore.
Okla. Eng. & Fdry. Co., Muskogee, Okla.
Otis Eng. Corp., N. Y.
Sheffield Tool & Sup. Co., Sheffield, Pa.
Squier-Rix Co., Milwaukee.

FORDSON LOCOMOTIVES
Adamson Motor Co., Birmingham, Ala.
Brookville Truck & Tractor Co., Brookville, Pa.

FORDSON POWER SHOVELS
*Anthony Co., Streator, Ill.
*Insley Mfg. Co., Indianapolis, Ind.
Glasgow Eng. Co., St. Louis, Mo.
Mandt Company, Keokuk, Ia.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee.
Squier-Rix Co., Milwaukee.

FORDSON ROAD GRADERS
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Eds. Mach. Co., Kennett Sq., Pa.
*Hadfield-Penfield Stl. Co., Bucyrus, O.
*Russell Grader Mfg. Co., Minneapolis
J. D. Adams & Co., Indianapolis, Ind.
Gilbert Mfg. Co., Aberdeen, S. D.
Shaw-Enochs Tractor Co., Minneapolis
Wehr Co. Milwaukee, Wis.

FORDSON ROAD ROLLERS
*Acme Road Mchy. Co., Frankfort, N. Y.
*Austin-Western Rd. Mach. Co., Chicago.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Eds. Mchy. Co., Kennett Sq., Pa.
Horst & Strieter Co., Davenport, Ia.

FORDSON SAW RIGS
*Amer. Saw Mill Mchy. Co., Hackettstown, N. J.
*Miami Trailer-Scraper Co., Troy, O.

FORDSON SCRAPER OUTFITS
*Miami Trailer-Scraper Co., Troy, O.
*Gustav Schaefer Wagon Co.,Cleveland,O.
Killefer Mfg. Co., Los Angeles, Calif.
Miskin Scraper Wks., Ucon, Idaho.

FORDSON TRACTION TREADS
*Belle City Mfg. Co., Racine, Wis.
*Full-Crawler Co., Milwaukee, Wis.
A. C. Johnson Products, Racine, Wis.
Tractor Grip Wheel Co., Toledo, O.

FORDSON TRACTOR TRUCKS
Toppins Trac. Truck Co., Appleton, Wis.

FORDSON TRAILER EQUIPMENT
*Easton Car & Const'n Co., Easton, Pa.
*Miami Trailer-Scraper Co., Troy, O.
Trail-Ford Corp., Ann Arbor, Mich.
Trailmobile Co., Cincinnati, O.
Troy Trailer & Wagon Co., Troy, O.
Whitehead & Kales Co., Detroit.

FORDSON TRUCK LOADERS
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*George Haiss Mfg. Co., N. Y.
*Spears-Wells Mchy. Co., Oakland, Cal.
Lessman Loader Mfg. Co., Des Moines, Ia.
Nelson Iron Wks., Passaic, N. J.
Specialty Eng. Co., Philadelphia, Pa.

FORGES
*Hauck Mfg. Co., B'lyn, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

FORGES, OIL (Rivet Heating)
*Hauck Mfg. Co., B'klyn, N. Y.
*Mead-Morrison Mfg. Co., E. Boston.

FORM CLAMPS
*Insley Mfg. Co., Indianapolis, Ind.
*M. & M. Wire Clamp Co., Minneapolis
Marion Mall. Iron Wks., Marion, Ind.
Universal Form Clamp Co., Chicago.

FORMS, CONCRETE
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Phila., Pa.
*Heltzel Stl. Form & Ir. Co., Warren, O.
*Hotchkiss Stl. Products Co., Binghamton, N. Y.
*Lakewood Eng. Co., Cleveland, O.
*Raber & Lang Mfg. Co., Kendallville, Ind.
*Truscon Steel Co., Youngstown, O.
Concrete Form Co., Inc., Syracuse, N.Y.
Metal Forms Corp., Milwaukee.

FORMGRADERS
Edward G. Carr, Chicago.

FOUNTAINS, DRINKING
Casey-Hedges Co., Chattanooga, Tenn.
Jas. B. Clow & Sons, Chicago.
Crane Co., Chicago.
Murdock Mfg. & Sup. Co., Cincinnati.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee.
Stewart Iron Wks. Co., Cincinnati, O.
Halsey W. Taylor Co., Warren, O.
20th Century Brass Wks., Bellevelle, Ill.

FURNITURE AND FILES, STEEL
Art Metal Const. Co., Jamestown, N.Y.
Gen. Fireproofing Co., Youngstown, O.
Van Dorn Ir. Wks. Co., Cleveland, O.

FURRING AND SLEEPER ANCHORS
Dayton Sure Grip & Shore Co., Dayton, O.

GARBAGE CANS (See Cans)

GARBAGE DISPOSAL
American Beccari Corp., N. Y.
Balmer Corp., N. Y.
C. O. Bartlett & Snow Co., Cleveland, O.
Decarie Incinerator Co., L. I. C., N. Y.
Goder Incinerator Corp., Chicago.
Hiler Eng. & Const. Co., B'klyn, N. Y.
Morse-Boulger Destructor Co., N. Y.
Nye Odorless Crematory Co., Macon, Ga.

GARBAGE TRUCKS AND BODIES
*Heil Co., Milwaukee, Wis.
*Watson Truck Corp., Canastota, N. Y.
Geo. H. Holabog & Bro., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago.
Tiffin Wagon Co., Tiffin, O.

GAS METERS (See Meters, Gas)

GAS PRODUCERS
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
R. D. Wood & Co., Phila., Pa.

GASOLINE STORAGE TANKS
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, O.
Birmingham Tank Co., B'mingham, Ala.
S. F. Bowser & Co., Inc., Ft. Wayne, Ind.
Chicago Bridge & Iron Wks., Chicago.
Graver Corp., E. Chicago, Ind.
Wm. B. Scaife & Sons, Pittsburgh, Pa.
Tokheim Oil Tank & Pump Co., Ft. Wayne, Ind.
United Iron Wks., Inc., K. City, Mo.
Wayne Tank & Pump Co, Ft. Wayne, Ind.

GATES, SLUICE
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
R. Hardesty Mfg. Co., Denver.
Ludlow Valve Mfg. Co., Troy, N. Y.

GATES FOR PARKS AND CEMETERIES
*Stewart Iron Wks. Co., Cincinnati, O.

GAUGES, WATER
Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston.

GUAGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
Builders Iron Fdry., Providence, R. I.
Simplex Valve & Meter Co., Phila., Pa.

GLASS, FIREPROOF (See Wire Glass)

GOVERNORS, GASOLENE ENGINE
*Pickering Governor Co., Portland, Ct.

GRADERS, ROAD (See Road Graders)

GRADER BLADES
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Russell Grader Mfg. Co., Minneapolis.
J. D. Adams & Co., Indianapolis, Ind.
Shunk Mfg. Co., Bucyrus, O.

GRAND STANDS, PORTABLE
Circle A. Prod. Corp., Newcastle, Ind.
Leavitt Mfg. Co., Urbana, Ill.
Wayne Iron Wks., Phila., Pa.

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Chicago Pneum. Tool Co., N. Y.
Cleveland Pneum. Tool Co., Cleveland, O.
Wm. H. Keller, Inc., Grand Haven, Mich.

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Johns-Manville, Inc., N. Y.

HEATING KETTLES (See Kettles)

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*Gustav Schaefer Wagon Co.,Cleveland,O.

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*Amer. Saw Mill Mchy. Co., Hackettstown, N. J.
*Dobbie Fdry. & Mach. Co., Niagara Falls.
*Harnischfeger Corp., Milwaukee, Wis.
*Lidgerwood Manufacturing Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Mundy Sales Corp., N. Y.
*Street Bros. Mach. Wks., Chatta., Tenn.
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Weller Mfg. Co., Chicago.

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*Insley Mfg. Co., Indianapolis, Ind.
*Lakewood Eng. Co., Cleveland, O.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Street Bros. Mach. Wks., Chattanooga
Ransome Conc. Mchy. Co., Dunellen, N.J.

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*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls
*S. Flery Mfg. Co., Bangor, Pa.
*Harnischfeger Corp., Milwaukee.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Mundy Sales Corp., N. Y.
*O.K. Clutch & Mach. Co., Columbia., Pa.
*Street Bros. Mach. Wks., Chatta., Tenn.
*Vulcan Iron Wks., Wilkes-Barre, Pa.
Am. Hoist & Derrick Co., St. Paul, Minn.
Chrisholm-Moore Mfg. Co., Cleveland, O.
Ntl. Hoisting Eng. Co., Harrison, N. J.
Thomas Elev. Co., Chicago.
Treadwell Eng. Co., Easton, Pa.

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*Amer. Saw Mill Mchy. Co., Hackettstown, N. J.

*Amer. Mfg. & Eng. Co., Kalamazoo, Mich.
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Constr. Mchy. Co., Waterloo, Ia.
*Domestic Eng. & Pump Co., Shippensburg, Pa.
*S. Flory Mfg. Co., Bangor, Pa.
*Harnischfeger Corp., Milwaukee.
*Lansing Co., Lansing, Mich.
*Lidgerwood Manufacturing Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Mundy Sales Corp., N. Y.
*Novo Engine Co., Lansing, Mich.
*O.K. Clutch & Mach. Co., Columbia, Pa.
*Pioneer Tractors, Inc., Winona, Minn.
*Street Bros. Mach. Wks., Chatta., Tenn.
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C. H. & E. Mfg. Co., Milwaukee.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Ersted Mchy. Mfg. Co., Portland, Ore.
Ntl. Hoisting Eng. Co., Harrison, N. J.
Orr & Sembower, Reading, Pa.
Schramm, Inc., West Chester, Pa.
Squier-Rix Co., Milwaukee.
Thomas Elevator Co., Chicago.

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*Curtis Pneum. Mchy. Co., St. Louis
*Dake Engine Co., Grand Haven, Mich.
*Denver Rock Drill Mfg. Co., Denver.
*Ingersoll-Rand Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Sullivan Mchy. Co., Chicago.
Chicago Pneumatic Tool Co., N. Y.
Detroit Hoist & Mach. Co., Detroit.
Gilman Mfg. Co., E. Boston, Mass.
Hanna Eng. Works, Chicago.
Independent Pneum. Tool Co., Chicago.
Northern Eng. Wks., Detroit, Mich.
Worthington Pump & Mchy. Corp., N.Y.

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*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dake Eng. Co., Grand Haven, Mich.
*Denver Rock Drill Mfg. Co., Denver.
*S. Flory Mfg. Co., Bangor, Pa.
*Ingersoll-Rand Co., N. Y.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Mundy Sales Corp., N. Y.
*Street Bros. Mach. Wks., Chattanooga
Amer. Hoist & Derrick Co., St. Paul, Minn.
Hardie-Tynes Mfg. Co., B'mingham, Ala
Ntl. Hoisting Eng. Co., Harrison, N. J.
Orr & Sembower, Reading, Pa.
Thomas Elev. Co., Chicago.
Treadwell Eng. Co., Easton, Pa.

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*Lidgerwood Mfg. Co., N. Y.
*Superior Body Corp., Marion, Ind.
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Borg & Beck Co., Chicago
Detroit Trailer & Mach. Co., Detroit.
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Rock Mfg. Co., Waterloo, N. Y.
Van Dorn Iron Wks., Cleveland, O.

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Wm. E. Dee Co., Chicago.
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Medal Paving Brick Co., Cleveland, O.
Metropolitan Pav. Brick Co., Canton, O.
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*Lakewood Eng. Co., Cleveland, O.
*Littleford Bros., Cincinnati, O.
*Ransome Conc. Mchy. Co., Dunellen, N.J.

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*Ingersoll-Rand Co., N. Y.
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Cincinnati Rubber Mfg. Co., Cincinnati.
Gilman Mfg. Co., E. Boston, Mass.
Goodyear Tire & Rubber Co., Akron, O.
Mulconroy Co., Inc., Phila., Pa.
Penna. Flexible Metallic Tubing Co., Phila., Pa.
Republic Rubber Co., Youngstown, O.
U. S. Rubber Co., N. Y.

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Eureka Fire Hose Mfg. Co., N. Y.
Fabric Fire Hose Co., N. Y.
B. F. Goodrich Rubber Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.

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Niagara Metal Stamping Corp., Niagara Falls, N. Y.

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Eddy Valve & Mfg. Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Ia.
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Norwood Eng. Co., Florence, Mass.
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A. P. Smith Mfg. Co., E. Orange, N. J.
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Rumsey Pump Co., Seneca Falls, N.Y.
Seattle Mach. Works, Seattle, Wash.

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Baker Ice Mach. Co., Omaha, Neb.
Brunswick-Kroeschell Co., N. Brunswick, N. J.
Carbondale Mach. Co., Carbondale, Pa.
De La Vergne Mach. Co., N. Y.
Frick Co., Inc., Waynesboro, Pa.
Triumph Ice Mach. Co., Cincinnati, O.
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Vilter Mfg. Co., Milwaukee, Wis.
Henry Vogt Mach. Co., Louisville, Ky.
York Mfg. Co., York, Pa.

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INDICATOR POSTS (See Valves)

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Allentown Testing Lab., Allentown, Pa.
E. L. Conwell & Co., Phila., Pa.
Gulick-Henderson Co., N. Y.
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Pittsburgh Testing Lab., Pittsburgh.
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*Chausse Oil Burner Co., Elkhart, Ind.
*Connery & Co., Inc., Phila., Pa.
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*Hauck Mfg. Co., B'klyn, N. Y.
*Jos. Honhorst Co., Cincinnati, O.
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*Universal Rd. Mach. Co., Kingston, N.Y.
Birmingham Tank Co., Bmingham, Ala.
Chase & Lyman, Boston, Mass.
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R. E. Dietz Co., N. Y.
Handlan, Buck Mfg. Co., St. Louis.
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Gen. Fireproofing Co., Youngstown, O.
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Northwestern Exp. Metal Co., Chicago.
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Sykes Metal Lath & Roofing Co., Niles, O.
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Coldwell Lawn Mower Co., Newburgh, N.Y.
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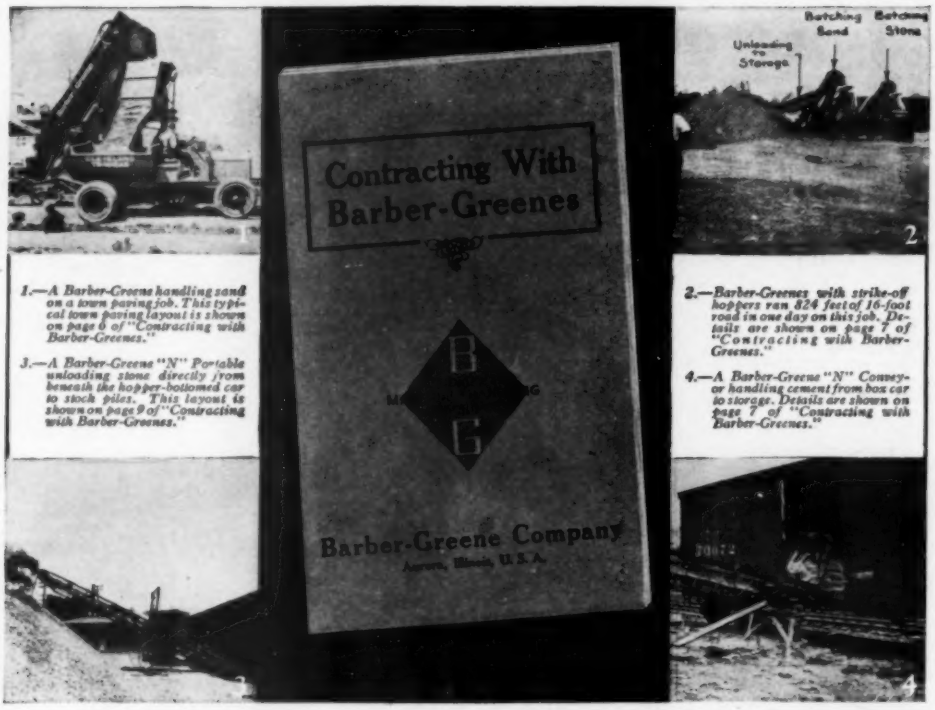
Ideal Power Lawn Mower Co., Lansing, Mich.
Jacobsen Mfg. Co., Racine, Wis.
Penna. Lawn Mower Wks., Phila., Pa.
Phila. Lawn Mower Co., Phila., Pa.



1.—A Barber-Greene handling sand on a town paving job. This typical town paving layout is shown on page 6 of "Contracting with Barber-Greenes."

2.—Barber-Greenes with strike-off hoppers ran 824 feet of 16-foot road in one day on this job. Details are shown on page 7 of "Contracting with Barber-Greenes."

3.—A Barber-Greene "N" Portable unloading stone directly from beneath the hopper-bottomed car to stock piles. This layout is shown on page 9 of "Contracting with Barber-Greenes."

4.—A Barber-Greene "N" Conveyor handling cement from box car to storage. Details are shown on page 7 of "Contracting with Barber-Greenes."

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Chicago Flexible Shaft Co., Chicago.
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Brookville Track & Tractor Co., Brookville, Pa.
Davenport Loc. Wks., Davenport, Ia.
Industrial Equip. Co., Minster, O.
Lima Loc. Wks., Lima, O.
Milwaukee Loc. Mfg. Co., Milwaukee.
Plymouth Loc. Wks., Plymouth, O.
H. K. Porter Co., Pittsburgh, Pa.
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METAL LATH (See "Lath")

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Clarksville Fdry. & Mach. Wks., Clarksville, Tenn.
J. B. Clow & Sons, Chicago.
Columbian Ir. Wks., Chattanooga, Tenn.
Ford Meter Box Co., Wabash, Ind.
Mueller Co., Decatur, Ill.

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*Neptune Meter Co., N. Y.
*Pittsburgh Meter Co., Pittsburgh, Pa.
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Ford Meter Box Co., Wabash, Ind.
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General Elec. Co., Schenectady, N. Y.
Sangamo Elec. Co., Springfield, Ill.
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Bailey Meter Co., Cleveland, O.
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*Pittsburgh Meter Co., Pittsburgh, Pa.
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National Meter Co., N. Y.
Thomson Meter Co., B'klyn, N. Y.
Worthington Pump & Mchy. Corp., N.Y.

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Simplex Valve & Meter Co., Phila., Pa.

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*Lakewood Eng. Co., Cleveland, O.
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Kent Mach. Co., Kent, O.
Union Iron Wks., Inc., Hoboken, N. J.

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*Koehring Co., Milwaukee, Wis.
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Kelly Springfield Motor Truck Co., Springfield, O.
Kissel Motor Car Co., Hartford, Wis.
Larrabee-Deyo Motor Tr. Co., Binghamton, N. Y.
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Republic Motor Tr. Co., Alma, Mich.
Service Motor Tr. Co., Wabash, Ind.
Standard Motor Truck Co., Detroit.
Sterling Motor Truck Co., Milwaukee.
Stewart Motor Corp., Buffalo, N. Y.
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United Motor Products Co., Grand Rapids, Mich.
U. S. Motor Truck Co., Cincinnati, O.
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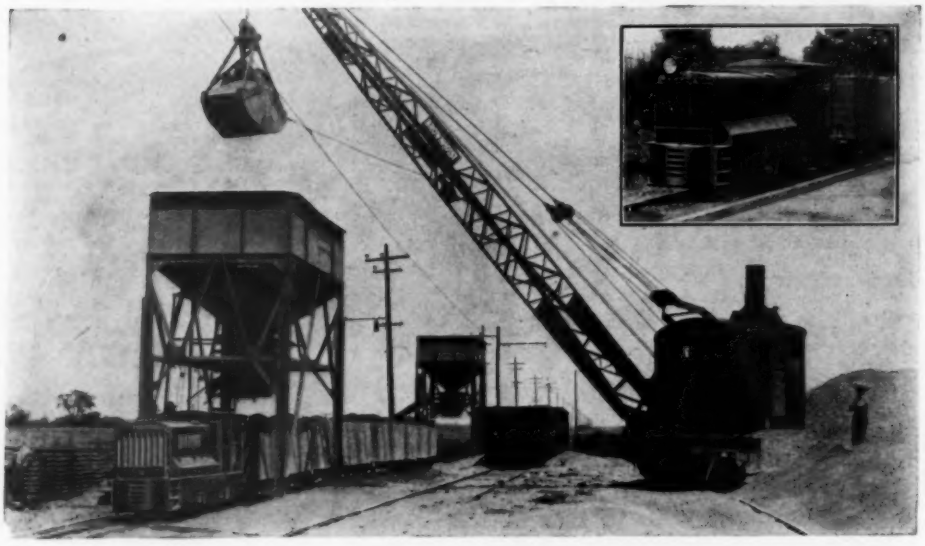

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Pioneer Asp. Co., Lawrenceville, Ill.
Standard Oil Co. (La.), N. Orleans, La.
Standard Oil Co. (N. J.), Newark, N. J.
Standard Oil Co. (N. Y.), N. Y.

OXY-ACETYLENE APPARATUS
*Alex. Milburn Co., Baltimore, Md.
Oxweld Acetylene Co., Long Island City, N. Y.

PACKING, WATER PIPE
*Union Water Meter Co., Worcester, Mass.
The Leadite Co., Phila., Pa.
United Lead Company, N. Y.

PAINT GUNS
*Alex. Milburn Co., Baltimore, Md.
Chicago Pneum. Tool Co., New York
De Vilbiss Mfg. Co., Toledo, O.
Simons Paint Spray Brush Co., Dayton, O.
Spray Sales Co., Boston.

PAINTS, METAL PROTECTION
*Barber Asphalt Co., Phila., Pa.
*Barrett Co., N. Y.
*Philip Carey Co., Cincinnati, O.
*Jos. Dixon Crucible Co., J. City, N. J.
*Solvay Process Co., N. Y.
Acme White Ld. & Col. Wks., Detroit.
Berry Bros., Detroit.
Cook Paint & Varnish Co., K. City, Mo.
Detroit Graphite Co., Detroit.
Detroit White Lead Wks., Detroit.
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Minwax Co., N. Y.
Protexol Corp., N. Y.
Ruberoid Co., N. Y.
Servicised Products Corp'n, Chicago
Sherwin-Williams Co., Cleveland, O.
L. Sonneborn Sons., Inc., N. Y.
Toch Bros., N. Y.
Tropical Paint & Oil Co., Cleveland, O.
Truscon Laboratories, Detroit.

PAPERS, BLUE PRINT
Ind'p'lis Blue Print & Supply Co., Ind'p'lis, Ind.

PAPER, BUILDING, ROOFING, ETC.
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*Philip Carey Co., Cincinnati, O.
*Barrett Co., N. Y.
Bird & Sons., Inc., E. Walpole, Mass.
Brown Co., Portland, Me.
Hydrox Asph. Prod. Corp., N. Y.
Johns-Manville, Inc., N. Y.
Nat. Roofing Co., Tonawanda, N. Y.
Ruberoid Co., N. Y.

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*Stewart Iron Wks. Co., Cincinnati, O.
Bausman Mfg. Co., Millersville, Pa.
Logan Co., Louisville, Ky.
Fred J. Meyers Mfg. Co., Hamilton, O.

PAVEMENT BREAKERS (See Breakers)

PAVING AND ROAD ROLLERS. (See Road and Paving Rollers)

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Alton Brick Co., Alton, Ill.
Binghamton Br. Co., Binghamton, N.Y.
Buckeye Shale Brick Co., Cleveland, O.
Buffalo Brick Co., Buffalo, Kans.
Cen. Clay Prod. Co., Wilkes-Barre, Pa.
Cleveland Brick & Clay Co., Cleveland, O.
Clydesdalle Brick & Stone Co., Pittsburgh, Pa.
Coffeyville Vit. Brick & Tile Co., Coffeyville, Kans.
Collinwood Shale Brick Co., Cleveland, O.
Corry Brick & Tile Corp., Corry, Pa.
Flint Brick Co., Des Moines, Ia.
Francis Vit. Brick Co., Boynton, Okla.
Georgia Vit. Brick Co., Augusta, Ga.
Hammond Fire Brick Co., Fairmount, W. Va.
Hocking Val. Brick Co., Columbus, O.
Independence Pav. Br. Co., Independence, Kans.
Layton Fire Clay Co., McKeesport, Pa.
McAvoy Vit. Brick Co., Phila., Pa.
C. P. Mayer Brick Co., Bridgeville, Pa.
Metropolis Pav. Br. Co., Pittsb'h, Kan.
Metropolitan Pav. Br. Co., Canton, O.
Mineral Wells Pav. Br. Co., Mineral Wells, Tex.
Moberly Pav. Br. Co., Moberly, Mo.
Murphysboro Pav. Brick Co., Murphysboro, Ill.
Nelsonville Brick Co., Nelsonville, O.
Patton Clay Mfg. Co., Patton, Pa.
Peebles Pav. Br. Co., Portsmouth, O.
Pittsburgh Pav. Br. Co., Pittsb'h, Kan.
Purington Pav. Br. Co., Galesburg, Ill.
Russell Clay Mfg. Co., Alton, Ala.
So. Clay Mfg., Chattanooga, Tenn.
Spfld. Pav. Br. Co., Springfield, Ill.
Sterling Brick Co., Olean, N. Y.
Streator Clay Mfg. Co., Streator, Ill.
Thornton Fire Brick Co., Clarksburg, W.V.
Thurber Brick Co., Thurber, Tex.
Toronto Fire Clay Co., Toronto, O.
Trinidad Br. & Tile Co., Trinidad, O.
Veedersburg Paver Co., Veedersburg, Ind.
West'n Shale Prod. Co., Ft. Scott, Kan.
Westport Pav. Br. Co., Westport, Md.

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*W. S. Godwin Co., Baltimore, Md.

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*Barber Asphalt Co., Phila., Pa.
*Chausse Oil Burner Co., Elkhart, Ind.
*Connery & Co., Inc., Phila., Pa.
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F. D. Cummer & Sons Co., Cleveland, O.
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Hendrick Mfg. Co., Carbondale, Pa.

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Iron City Tool Wks., Pittsburgh.
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Verona Tool Wks., Verona, Pa.
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*McKiernan-Terry Drill Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Union Iron Wks., Chicago
Browning Co., Cleveland, O.
Industrial Wks., Bay City, Mich.
McMyler Interstate Co., Cleveland, O.

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*Union Iron Wks., Chicago
Industrial Wks., Bay City, Mich.
Ntl. Hoisting Eng. Co., Harrison, N. J.
Vulcan Iron Wks., Chicago.

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MacArthur Conc. Pile & F'd'n Co., N.Y.
Raymond Conc. Pile Co., N. Y.

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Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Stl. Co., Pittsburgh

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Central Fdry. Co., N. Y.
J. B. Clow & Sons, Chicago.
Donaldson Iron Co., Emaus, Pa.
John Fox & Co., N. Y.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Fdry. Co., Lynchburg, Va.
McWane C. I. Pipe Co., Birmingham, Ala.
Nat. C. I. Pipe Co., Birmingham, Ala.
Standard C. I. Pipe & Fdry. Co., Atlanta, Ga.
Warren Fdry. & Machine Co., N. Y.
R. D. Wood & Co, Phila., Pa.

PIPE, CULVERT (See Culverts)

PIPE, LEAD
United Lead Company, N. Y.

PIPE, REINFORCED CONCRETE
*Newark Conc. Pipe Co., Newark, N. J.
Concrete Prod. Co., Pittsburgh, Pa.
Core Joint Conc. Pipe Co., Baltimore.
Independent Conc. Pipe Co., Indianapolis.
Lock Joint Pipe Co., E. Orange, N. J.
Massey Conc. Prod. Corp., Chicago.

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*Blaw-Knox Co., Pittsburgh, Pa.
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*Jos. Honhorst Co., Cincinnati, O.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., Newburg, N.Y.
American Spiral Pipe Wks., Chicago.
Canton Culvert & Silo Co., Canton, O.
Chatta. Boiler & Tk. Co., Chatta., Tenn.
Chicago Bridge & Ir. Wks., Chicago.
E. Jersey Pipe Co., N. Y.
Hammond Ir. Wks., Warren, Pa.
R. Hardesty Mfg. Co., Denver.
Lancaster Iron Wks., Lancaster, Pa.
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1. Depth of subgrade and height of swing.
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3. Full caterpillar mounting — new large caterpillar shoes—pressure per square inch on ground only 8 pounds.
4. Character of the soil is plainly shown in this unretouched picture, but tough as it is, the Bear Cat handles it easily.
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Jones & Laughlin Stl. Co., Pittsburgh.
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Republic Ir. & Stl. Co., Youngstown, O.
South Chester Tube Co., Chester, Pa.
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Wheeling Stl. Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

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Mich. Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., S. Francisco.
Redwood Mfrs. Co., S. Francisco.
Standard Wd. Pipe Co., Williamsport, Pa.
A. Wyckoff & Sons Co., Elmira, N. Y.

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Reading Iron Co., Reading, Pa.

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Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mountain Co., Chicago
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Ric-WiL Co., Cleveland, O.
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Builders Iron Fdry., Providence, R. I.
Central Fdry. Co., N. Y.
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Donaldson Iron Co., Emaus, Pa.
Lunkenheimer Co., Cincinnati, O.
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*Caterpillar Trac. Co., San Leandro, Cal
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Russell Grader Mfg. Co., Minneapolis.
*Wiard Plow Co., Batavia, N. Y.
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Deere & Co., Moline, Ill.
International Harvester Co., Chicago.
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Oliver Chilled Plow Wks., S. Bend, Ind.
Roderick Lean Mfg. Co., Mansfield, O.
Sidney Steel Scraper Co., Sidney, O.
Slusser-McLean Scraper Co., Sidney, O.
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United Brass Mfg. Co., Cleveland, O.
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*Littleford Bros., Cincinnati, O.
*Truscon Steel Co., Youngstown, O.
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PORTABLE WOOD WORKERS
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PORTLAND CEMENT (See Cement)

POWDER (See Explosives)

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*Climax Eng. Co., Clinton, Ia.
*Continental Motors Corp., Detroit, Mich.
*Hercules Corp., Evansville, Ind.
*Hercules Motors Corp., Canton, O.
*Hinkley Motors, Inc., Detroit.
Sanderson-Cyclone Drill Co., Orrville, O.

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*Am. Stm. Pump Co., Battle Creek, Mich.
*Sullivan Mach. Co., Chicago.
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Indiana Air Pump Co., Indianapolis.
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Dean Hill Pump Co., Anderson, Ind.
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Deming Co., Salem, O.
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Fairbanks, Morse & Co., Chicago.
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Indiana Air Pump Co., Indianapolis.
LeCourtenay Co., Newark, N. J.
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Ramsey Pump Co., Seneca Falls, N.Y
Scranton Pump Co., Scranton, Pa.
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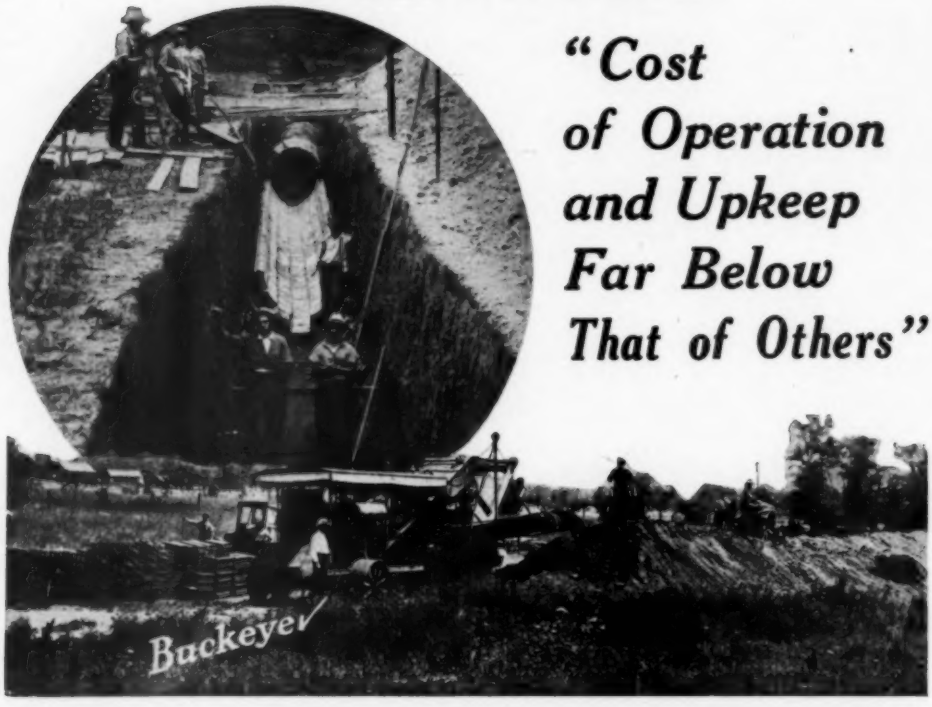

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Barnes Mfg. Co., Mansfield, O.
Dayton-Dowd Co., Quincy, Ill.
De Laval Stm. Turb. Co., Trenton, N.J.
Deming Co., Salem, O.
Evinrude Motor Co., Milwaukee.
Fairbanks, Morse & Co., Chicago.
Gardner Governor Co., Quincy, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis.
Kinney Mfg. Co., Boston
Lawrence Mach. Co., Lawrence, Mass.
LeCourtenay Co., Newark, N. J.
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Nordberg Mfg. Co., Milwaukee.
Northern Fire App. Co., Minneapolis.
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Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Mchy. Corp., N.Y.
Yeomans Bros. Co., Chicago

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Sanitation Corp., N. Y.
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Modine Mfg. Co., Racine, Wis.
Racine Radiator Co., Racine, Wis.

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Alliance Machine Co., Alliance, O.
Chicago Pneum. Tool Co., New York
Cleveland Pneum. Tool Co., Cleveland, O.
Hanna Eng. Works, Chicago.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneum. Tool Co., Chicago.
Wm. H. Keller, Inc., Grand Haven, Mich.
Watson-Stillman Co., N. Y.

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Chicago Pneum. Tool Co., New York
Cleveland Pneum. Tool Co., Cleveland, O.
Dunbar Drop Forge Co., Chicago.
Independent Pneum. Tool Co., Chicago.

ROAD GRADERS
*Austin-West'n Rd. Mchy. Co., Chicago.
*Baker Mfg. Co., Springfield, Ill.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Rds. Mchy. Co., Kennett Sq., Pa.
*Hadfield-Penfield Stl. Co., Bucyrus, O.
*Russell Grader Mfg. Co., Minneapolis.
J. D. Adams & Co., Indianapolis, Ind.
J. I. Case Threshing Mach. Co., Racine, Wis.
Gilbert Mfg. Co., Aberdeen, S. D.
Killefer Mfg. Co., Los Angeles
Lyle Culv. & Rd. Equip. Co., Minneapolis
N. S. Monroe & Sons, Arthur, Ill.
Owensboro Ditcher & Grader Co., Owensboro, Ky.
Shaw-Enochs Tractor Co., Minneapolis
Stockland Rd. Mach. Co., Minneapolis.
Western Wheeled Scraper Co., Aurora, Ill.

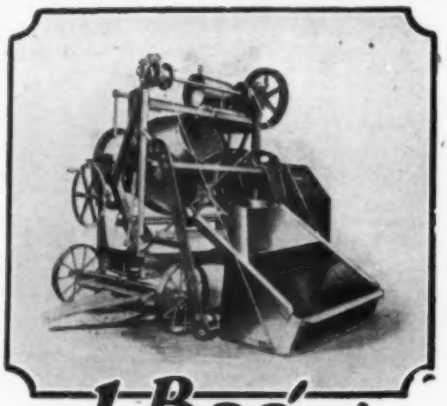
ROAD OILS (See Oils, Road)

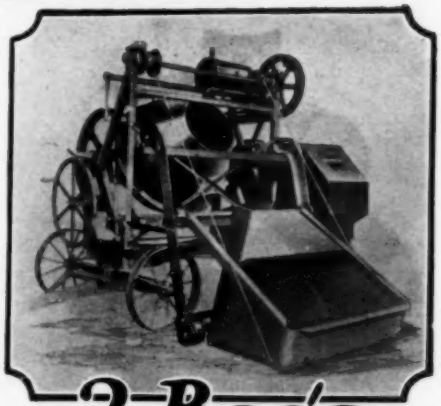
ROAD OILERS
*Austin-West'n Rd. Mchy. Co., Chicago.
*Connery & Co., Phila., Pa.
*Good Rds. Mchy. Co., Kennett Sq., Pa.
*Mack Trucks, Inc., N. Y.
*Spears-Wells Mchy. Co., Oakland, Cal.
F. D. Etnyre & Co., Oregon, Ill.
Kinney Mfg. Co., Boston
White Co., Cleveland, O.

ROAD SCRAPERS
*Acme Rd Mach. Co., Frankfort, N. Y.
*Austin-West'n Rd. Mchy. Co., Chicago
*Baker Mfg. Co., Springfield, Ill.
*Euclid Cr. & Hst. Co., Euclid Village, O.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Rds. Mchy. Co., Kennett Sq., Pa.
*Miami Trailer-Scraper Co., Troy, O.
*Russell Grader Mfg. Co., Minneapolis.
*Gustav Schaefer Wagon Co., Cleveland, O.
J. D. Adams & Co., Indianapolis, Ind.
J. I. Case Threshing Mach. Co., Racine, Wis.
Gilbert Mfg. Co., Aberdeen, S. D.
Killefer Mfg. Co., Los Angeles
Lyle Culv. & Rd. Equip. Co., Minneapolis.
Root Spring Scraper Co., Kalamazoo, Mich.
Shaw-Enochs Tractor Co., Minneapolis
Sidney Steel Scraper Co., Sidney, O.
Stockland Rd. Mchy. Co., Minneapolis.
Western Wheeled Scraper Co., Aurora, Ill.

ROAD AND PAVING ROLLERS
*Austin-West'n Rd. Mchy. Co., Chicago.
*Barber Asphalt Co., Phila., Pa.
*Buffalo-Springfield Roller Co., Springfield, O.
*Galion Ir. Wks. & Eng. Co., Galion, O.
*Good Rds. Mach. Co., Kennett Sq., Pa.
*Huber Mfg. Co., Marion, O.
J. I. Case Threshing Mach. Co., Racine, Wis.
Erie Mach. Shops, Erie, Pa.
Horst & Strieter Co., Davenport, Ia

ROAD AND PAVING MACHINERY
*Acme Rd. Mach. Co., Frankfort, N. Y
*Atlas Eng. Co., Milwaukee.
*Austin-West'n Rd. Mchy. Co., Chicago
*Baker Mfg. Co., Springfield, Ill.
*Barber Asphalt Co., Phila., Pa.
*Blaw-Knox Co., Pittsburgh, Pa.
*Buffalo-Springfield Roller Co., Springfield, O.
*Caterpillar Tractor Co., San Leandro, Cal., and Peoria, Ill.
*Chausse Oil Burner Co., Elkhart, Ind.
*Connery & Co., Inc., Phila., Pa.
*Easton Car & Const. Co., Easton, Pa.
*Equitable Asph. Maint. Co., K. City, Mo.
*Euclid Cr. & Hst. Co., Euclid Village, O.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Rds. Mach. Co., Kennett Sq., Pa.
*Geo. Haiss Mfg. Co., N. Y.
*Jos. Honhorst Co., Cincinnati, O.
*Koehring Co., Milwaukee.
*Lakewood Eng. Co., Cleveland, O.
*Littleford Bros., Cincinnati, O.
*Mack Trucks, Inc., N. Y.
*Russell Grader Mfg. Co., Minneapolis.
*T. L. Smith Co., Milwaukee.
*Spears-Wells Mchy. Co., Oakland, Cal.
*Universal Rd. Mchy. Co., Kingston, N. Y.
J. D. Adams & Co., Indianapolis, Ind.
J. I. Case Threshing Machine Co., Racine, Wis.
F. D. Cummer & Son Co., Cleveland, O.
C. D. Edwards Mfg. Co., Albert Lea, Minn.
Erie Mach. Shops, Erie, Pa.
J. D. Farasey Co., Cleveland, O.
Gilbert Mfg. Co., Aberdeen, S. Dak.
Glide Rd. Mchy. Co., Minneapolis.
The Hug Co., Highland, Ill.
Killefer Mfg. Co., Los Angeles
Kinney Mfg. Co., Boston
Lyle Culv. & Rd. Equip. Co., Minneapolis.
N. S. Monroe & Sons, Arthur, Ill.
Shaw-Enochs Tractor Co., Minneapolis
Stockland Rd. Mchy. Co., Minneapolis.
United Iron Wks., Inc., K. City, Mo.





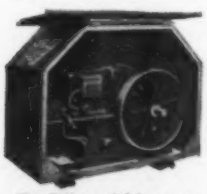
1 Bag 2 Bags

WONDER MIXERS

for the big jobs!

Wonder "7"

Here's one of the best all 'round sizes in the WONDER line. It has an approximate capacity of 10½ cu. ft. of unmixed material or 7 cu. ft. of mixed concrete. It's a speedy, sturdy one-bag machine, and is guaranteed to give many years of economical and profitable mixer service. Its extreme simplicity combined with rigid construction insure low operating costs, continuous service and long life. It will speed up your work, increase your daily output, and earn more profits for you.



The Fuller and Johnson engine is standard equipment on the WONDER "7". It's a horizontal, single cylinder, hopper cooled four cycle engine that will give dependable power at all times.

Wonder "10"

Popular demand for a dependable two-bag mixer produced this newest WONDER design. It has a capacity of 10 cubic feet of mixed concrete and will handle a 2 bag batch or proportions up to and including 1-2-5 mix. The "10" has all the WONDER features, many of them exclusive, such as the perfectly balanced mixing drum—a track type of loader with its extension advantages—a thrust screw type of loader clutch with an automatic knockout and Alemite lubrication.

SEND today for complete information and new low prices on either of the two WONDERS pictured above or any size mixer you are interested in. Our complete catalog is Free for the asking. It illustrates the entire WONDER line — WONDER exclusive fundamental features and all 1926 improvements.

The two cylinder, Le Roi engine is furnished with the WONDER "10". It's a lightweight, heavy-duty industrial engine, built for continuous full-load service. Guaranteed absolutely.

Construction Machinery Company

WATERLOO, IOWA, U. S. A.

Western Office
465 East 3d St., Los Angeles, Cal.

Central Office
315 W. Maryland St., Indianapolis, Ind.

Eastern Office
Widener Bldg., Philadelphia, Pa.

ROCK CRUSHERS AND PULVERIZERS (See "Crushers")

ROCK DRILLS (See Drills, Rock)

ROOFING, ASPHALT, COMPOSITION, TILE, ETC.
*Barber Asphalt Co., Phila., Pa.
*Barrett Co., N. Y.
*Philip Carey Co., Cincinnati, O.
*Standard Oil Co. (Indiana), Chicago.
*Texas Co., N. Y.
Amer. Cem. Tile Mfg. Co., Pittsburgh.
Atlantic Ref. & Asph. Corp., Phila., Pa.
Beaver Prod. Co., Inc., Buffalo, N. Y.
Bird & Son, Inc., E. Walpole, Mass.
Certain-teed Products Corp., N. Y.
Chatfield Mfg. Co., Cincinnati, O.
Edwards Mfg. Co., Cincinnati, O.
Flintkote Co., Boston.
Johns-Manville, Inc., N. Y.
Keystone Roofing Mfg. Co., York, Pa.
The Lehon Co., Chicago.
F. J. Lewis Mfg. Co., Chicago.
Nat'l Roofing Co., Tonawanda, N. Y.
Ruberoid Co., N. Y.
Sall Mountain Co., Chicago.
Sifo Prod. Co., St. Paul, Minn.
L. Sonneborn & Sons, Inc., N. Y.
Western Elaterite Roofing Co., Denver.

ROOFING, METAL
*Truscon Steel Co., Youngstown, O.
Amer. Rolling Mill Co., Middletown, O.
Amer. Sheet & Tin Plate Co., Pittsb'h.
Berger Mfg. Co., Canton, O.
Edwards Mfg. Co., Cincinnati, O.
Klauer Mfg. Co., Dubuque, Ia.
Milwaukee Corr. Co., Milwaukee
Nat'l Sheet Metal Roofing Co., J. City, N. J.
United Alloy Steel Corp., Canton, O.
Youngstown Sheet & Tube Co., Youngstown, O.

ROOFING KETTLES (See Kettles)

ROPE, MANILA
Amer. Mfg. Co., B'klyn, N. Y.
Columbian Rope Co., Auburn, N. Y.
Cupples Cordage Co., B'klyn, N. Y.
Hooven & Allison Co., Xenia, O.
R. A. Kelly Co., Xenia, O.
N. Bedford Cordage Co., N. Bedford, Mass.
Peoria Cordage Co., Peoria, Ill.
Plymouth Cordage Co., N. Plymouth, Mass.
Portland Cordage Co., Portland, Ore.
Tubbs Cordage Co., San Francisco.
Wall Rope Wks., N. Y.
Waterbury Co., N. Y.
Whitlock Cordage Co., N. Y.

ROPE, WIRE, HOISTING, HAULAGE
*W'msport Wire Rope Co., W'msport, Pa.
Amer. Cable Co., Inc., N. Y.
Amer. Steel & Wire Co., Chicago.
Broderick & Bascom Rope Co., St. Louis, Mo.
A. Leschen & Sons Rope Co., St. Louis.
Fischer & Hayes Rope & Steel Co., Chicago.
Macwhyte Co., Kenosha, Wis.
J. A. Roebling's Sons Co., Trenton, N.J.
Upson-Walton Co., Cleveland, O.
Waterbury Co., N. Y.
Wickwire Spencer Steel Co., N. Y.

RUBBER TIRES (See Tires)

RULES
*Lufkin Rule Co., Saginaw, Mich.

SALAMANDERS
*Littleford Brothers, Cincinnati, O.

SAFETY TREADS (See Treads, Safety)

SASH, ROLLER STEEL (See Window Frames and Sash)

SAW RIGS PORTABLE
*Amer. Saw Mill Mach. Co., Hackettstown, N. J.
C. H. & E. Mfg. Co., Milwaukee.
Knickerbocker Co., Jackson, Mich.
Leach Co., Oshkosh, Wis.
Jones Superior Mach. Co., Chicago.

SCARIFIERS
*Acme Rd. Mach. Co., Frankfort, N.Y.
*Austin-West'n Rd. Mchy. Co., Chicago
*Barber Asphalt Co., Phila., Pa.
*Buffalo-Springfield Roller Co., Springfield, O.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Rds. Mach. Co., Kennett Sq., Pa.
*Huber Mfg. Co., Marion, O.
*Russell Grader Mfg. Co., Minneapolis.
*Universal Rd. Mchy. Co., Kingston, N.Y.

SCARIFIERS, TEETH FOR
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Russell Grader Mfg. Co., Minneapolis.
Skunk Mfg. Co., Bucyrus, O.

SCRAPERS, DRAGLINE
*Jackson Mfg. Co., Harrisburg, Pa.
*Russell Grader Mfg. Co., Minneapolis
*Sauerman Bros., Chicago

SCRAPERS, POWER DRAG
*Russell Grader Mfg. Co., Minneapolis
*Sauerman Bros., Chicago

SCRAPERS, ROAD (See Road Scrapers)

SCRAPERS, SELF-LOADING
*Baker Mfg. Co., Springfield, Ill.
*Euclid Cr. & Hst. Ct., Euclid Village, O.
*Miami Trailer-Scraper Co., Troy, O.
*Russell Grader Mfg. Co., Minneapolis
Shaw-Enochs Tractor Co., Minneapolis

SCREENS, SAND, GRAVEL AND COAL
*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Rd. Mchy. Co., Chicago
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Good Roads Mchy. Co., Kennett Sq., Pa.
*Haiss Mfg. Co., N. Y.
*Littleford Bros., Cincinnati, O.
*Russell Grader Mfg. Co., Minneapolis
*Universal Rd. Mach. Co., Kingston, N.Y.
Allis-Chalmers Mfg. Co., Milwaukee
Austin Mfg. Co., Chicago
Brown Hstg. Machy. Co., Cleveland, O.
C. O. Bartlett & Snow Co., Cleveland, O.
J. I. Case Threshing Mach. Co., Racine, Wis.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Morrow Mfg. Co., Wellston, O.
Newaygo Eng. Co., Newaygo, Mich.
New Jersey Wire Cloth Co., Trenton, N. J.
Robbins Conv. Belt Co., N. Y.
H. B. Sackett Screen & Chute Co., Chicago
Webster Mfg. Co., Chicago
Weller Mfg. Co., Chicago
Wickwire Spencer Steel Co., N. Y.

SCREENS, SEWAGE
Green Bay Fdry. & Mach. Wks., Green Bay, Wis.
Link-Belt Co., Philadelphia.
Sanitation Corp'n., N. Y.
Simplex Ejector Co., Chicago.

SEWAGE DISPOSAL APPARATUS
*Pacific Flush Tank Co., Chicago & N. Y.
Dorr Co., N. Y.
Sanitation Corp'n., N. Y.
Simplex Ejector Co., Chicago.

SEWAGE PUMPS (See Pumps)

SEWAGE EJECTORS
*Pacific Flush Tank Co., Chicago & N. Y.
Sanitation Corp., N. Y.
Simplex Ejector Co., Chicago.
Yeomans Bros. Co., Chicago.

SEWER BLOCKS, SEGMENT
American Vit. Products Co., Akron, O.
Cannelton Sewer Pipe Co., Cannelton, Ind.
Denver Sewer Pipe & Clay Co., Denver, Col.
W. S. Dickey Clay Mfg. Co., Kansas City, Mo.
Evens & Howard Fire Brick Co., St. Louis, Mo.
Laclede Christy Clay Prod. Co., St. Louis, Mo.
Macomb Sewer Pipe Wks., Macomb, Ill.
Pacific Clay Prod. Co., L. Angeles, Cal.
Red Wing Sewer Pipe Co., Red Wing, Minn.
Robinson Clay Prod. Co., Akron, O.
Standard Fire Brick & Sewer Pipe Co., Pueblo, Col.

SEWER CLEANING APPARATUS
*P. Bissell Co., Toledo, O.
Champion Corp., Hammond, Ind.
Self Propelling Nozzle Co., N. Y.
Turbine Sewer Mach. Co., Milwaukee.

SEWER PIPE AND DRAIN TILE
American Vit. Prod. Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis
Wm. E. Dee Co., Chicago.
Delaware Clay Prod. Co., Pittsburgh, Pa.
Denver Sewer Pipe & Clay Co., Denver, Col.
W. S. Dickey Clay Mfg. Co., K. City, Mo.
Logan Clay Prod. Co., Logan, O.
National Fireproofing Co., Pittsburgh, Pa.
Ohio Vit. Pipe Co., Uhrichsville, O.
Robinson Clay Prod. Co., Akron, O.

SEWER PIPE FORMS
*Raber & Lang Mfg. Co., Kendallville, Ind.
Quinn Wire & Iron Wks., Boone, Ia.

SEWER PIPE JOINT COMPOUNDS
G. K. Sales Agency, Macungie, Pa.
Ruberoid Co., N. Y.
Servicised Prod. Corp., Chicago

SEWER RODS
F. Bissell Co., Toledo, O.
Champion Corp., Hammond, Ind.
P. J. Healy, Jersey City, N. J.
Luck Sewer Equip. Co., Chicago
Turbine Sewer Mach. Co., Milwaukee

SHINGLES, METAL
Aluminum Co. of Am., Pittsburgh, Pa.
Berger Mfg. Co., Canton, O.
Canton Art Metal Co., Canton, O.
Edwards Mfg. Co., Cincinnati, O.
Klauer Mfg. Co., Dubuque, Ia.
Milwaukee Corrugating Co., Milwaukee.
Nat'l Sheet Metal Roofing Co., Jersey City, N. J.
Newport Rolling Mill Co., Newport, Ky.
Penn Metal Co., Boston.
Tiffin Art Metal Co., Tiffin, O.
Wheeling Metal Mfg. Co., Wheeling, W. Va.

SHORES
*M. & M. Wire Clamp Co., Minneapolis
Dayton Sure Grip & Shore Co., Dayton, O.

Now—At a Lower Price

Production Has Never Caught Up to Orders on the Smith Mascot

When we first showed our latest Mixer — the Smith "Mascot" (2½-S) to a successful contractor, he examined every part — the cut gears, the balanced, typical Smith tilting drum, the easy fast method of tilting from either side, the all steel frame.

Considering these features —the apparent saving in time and labor — the long service which the Mascot was bound to give, he felt that the construction of this mixer would necessarily mean a very high price.

As a matter of fact, before all the material and labor costs were collected we felt the same.

At about this time, some of our distributors heard about the Mascot and just on the Smith reputation—began to sell some sight unseen.

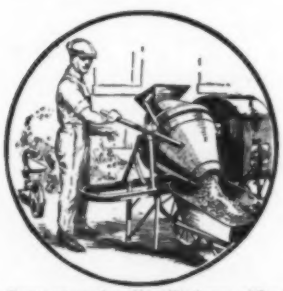
We decided, therefore, to plan larger production and with new modern machinery were able to offer the 2½-S Mixer, the Smith Mascot, at a remarkably attractive price.

The sales and performance both were more than satisfactory — sufficiently so that production per day has now been stepped up and—what is more important to the users—the prices have been brought down.

Our Catalog 500 gives detailed information on the Smith line. Tell us to mail you a copy now that you're thinking about mixers.

Smith Mascot (2½-S Tilter). Holds a full wheelbarrow of concrete; capacity from 25 to 45 cu. yds. per day.

Light Weight (only 730 lbs.) and trailer truck allows easy shifting and moving from job to job.



Easy "one hand" tilt from either side of mixer.

THE T. L. SMITH COMPANY
1030 32nd Street, Milwaukee, Wisconsin
Sales Offices and Service Stations in all Principal Cities

Smith Tilting Mixers are built in the following sizes: 2½, 3½, 5, 7, 10, 14, 21, 28, 40, 56 and 112 cu. ft. per batch; Smith Non-Tilting Mixers: 7, 14, 21 and 28 cu. ft. batch; Smith Paving Mixers: 27-E.

SMITH MIXERS

The O. D. G. Co., Owensboro, Ky.
H. W. Roos Co., Cincinnati, O.
Roos-Meyer-Hecht Co., Cincinnati, O.
Symons Clamp & Mfg. Co., Chicago.
Universal Form Clamp Co., Chicago.

SHOVELS, ELECTRIC
*Bay City Dredge Wks., Bay City, Mich.
*Byers Mach. Co., Ravenna, O.
*Koehring Co., Milwaukee, Wis.
*Marion Steam Shovel Co., Marion, O.
Bucyrus Co., So. Milwaukee, Wis.
Osgood Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, GASOLINE
*Bay City Dredge Wks., Bay City, Mich.
*Byers Mach. Co., Ravenna, O.
*Harnischfeger Corp., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
Amer. Steel Dredge Co., Ft. Wayne, Ind.
Austin Mach. Corp., Muskegon, Mich.
Brown Hstg. Machy. Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Erie Steam Shovel Co., Marion, O.
McMyler Interstate Co., Cleveland, O.
Osgood Co., Marion, O.
Speeder Machy. Corp., Fairfield, Ia.
Thew Shovel Co., Lorain, O.

SHOVELS, HAND
Ames Shovel & Tool Co., Boston.
Beall Bros. Co., Alton, Ill.
Conneaut Shovel Co., Conneaut, O.
Hubbard & Co., Pittsburgh, Pa.
Indiana Shovel Co., New Castle, Ind.
Jackson Shovel Co., Montpelier, Ind.
Pittsburgh Shovel Co., Pittsburgh, Pa.
Russell Shovel Co., Aliquippa, Pa.
Stevens-Webb Co., Inc., Altoona, Pa.
Union Furnace Mfg. Co., Altoona, Pa.
Wood Shovel & Tool Co., Piqua, O.
Wyoming Shovel Wks., Wyoming, Pa.

SHOVELS, STEAM
*Byers Mach. Co., Ravenna, O.
*Erie Steam Shovel Co., Erie, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
Austin Mach. Corp., Muskegon, Mich.
Bellwood Stm. Shovel Co., Bellwood, Pa.
Browning Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Erie Steam Shovel Co., Erie, Pa.
Industrial Wks., Bay City, Mich.
Osgood Co., Marion, O.
Russell & Co., Massillon, O.
Thew Shovel Co., Lorain, O.

SIGNS, STREET AND ROAD
Auto Sign Display Co. of Mo., St. Louis, Mo.
Automatic Signal & Sign Co., Chicago.
Baltimore Enam. & Nov. Co., Baltimore.
Cavanagh Bros. & Co., N. Y.
Elkhart Fdry. & Mach. Co., Elkhart, Ind.
Everna-Century Sign Co., Boston.
Hamilton Metal Prod. Co., Hamilton, O.
Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
Lyle-Signs, Minneapolis, Minn.
Municipal Street Sign Co., N. Y.
Rochester Street Signal Co., Rochester, N. Y.
Union Iron Prod. Co., E. Chicago, Ind.
Universal Traffic Control Co., Okla. City, Okla.
Western Display & Mfg. Co., St. Paul.

SIGNS, TRAFFIC
Acme Traffic Signal Co., Los Angeles.
Adams & Westlake, Chicago.
Auto Sign Display Co. of Mo., St. Louis, Mo.
Automatic Signal & Sign Co., Chicago.
Automatic Signal & Sign Co., Canton, O.
Amer. Gas Accumulator Co., Elizabeth, N. J.
Crouse-Hinds Co., Syracuse, N. Y.
Elkhart Fdry. & Mach. Co., Elkhart, Ind.
Essco Mfg. Co., Peoria, Ill.
Everna-Century Sign Co., Boston.
Griswold Safety Signal Co., Minneapolis.
Horni Signal Mfg. Corp., Newark, N. J.
Klug & Smith Co., Milwaukee, Wis.
Line Material Co., So. Milwaukee, Wis.
Little Giant Co., Mankato, Minn.
Lyle-Signs, Minneapolis, Minn.
Nat'l. Traffic Signal Corp., Chicago.
Ohio Traffic Devices Co., Columbus, O.
Tokheim Oil Tank & Pump Co., Ft. Wayne, Ind.
Traffic Sign & Signal Co., Gloucester, Mass.
Traffic Signal Corp., N. Y.
Union Iron Prod. Co., E. Chicago, Ind.

SLATE, ROOFING
Vendor Slate Co., Inc., Easton, Pa.

SLATE, STRUCTURAL
Keenan Struct. Slate Co., Bangor, Pa.
Penna. Struct. Slate Co., Easton, Pa.
Phoenix Slate Co., Windgap, Pa.
Stephens-Jackson Co.,Pen Argyl, Pa.
Structural Slate Co., Pen Argyl, Pa.

SLEEVES, TAPPING AND VALVE
Mueller Company, Decatur, Ill.
Rensselaer Valve Co., Troy, N. Y.
A. P. Smith Mfg. Co., East Orange, N. J.

SLUICE GATES (See Gates, Sluice)

SMOKE STACKS (See Stacks, Steel)

SNOW CLEANING MACHINERY
*Austin-Western Rd. Machy. Co., Chicago.
*Baker Mfg. Co., Springfield, Ill.
*Barber-Greene Co., Aurora, Ill.
*Caterpillar Tractor Co., San Leandro, Calif. and Peoria, Ill.
*Cleveland Tractor Co., Cleveland, O.
*Galion Iron Wks. & Mfg. Co., Galion, O.
*Good Rds. Mach. Co., Kennett Sq., Pa.
*La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
*Mack Trucks, Inc., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Monarch Tractors, Inc., Watertown, Wis.
*Russell Grader Mfg. Co., Minneapolis.
C. D. Edwards Mfg. Co., Albert Lea, Minn.
Hiway Service Corp., Wasau, Wis.
Killefer Mfg. Co., Los Angeles, Cal.
Owensboro Ditcher & Grader Co., Owensboro, Ky.
Rotary Snow Plow Co., Minneapolis.
Shaw-Enochs Tractor Co., Minneapolis
W. M. Toy Co., Sidney, O.
Union Iron Wks., Inc., Bangor, Me.
Walsha Holyoke St. Blr. Wks., Holyoke, Mass.

SPADES (See Shovels)

SPRAYERS, ASPHALT AND TAR
*Kinney Mfg. Co., Boston.

SPRAYING MACHINERY FOR TREES
Bean Spray Pump Co., Lansing, Mich.
Field Force Pump Co., Elmira, N. Y.
Fitzhenry-Guptill Co., E. Cambridge, Mass.

SPREADERS, STONE
*Austin-Western Rd. Mchy. Co., Chicago.
*Burch Plow Wks. Co., Crestline, O.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
Shaw-Enochs Tractor Co., Minneapolis

STACKS, STEEL
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Inc., Philadelphia.
*Heil Co., Milwaukee, Wis.
*Jos. Honhorst Co., Cincinnati, O.
*Littleford Bros., Cincinnati, O.
*N. Y. Central Iron Wks. Co., Inc., Hagerstown, Md.
Birmingham Tank Co., Birmingham, Ala.
Chatta. Boiler & Tank Co., Chatta., Tenn.
Chicago Bridge & Iron Wks., Chicago.
Graver Corp., Chicago
Petroleum Iron Wks. Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
W. B. Scaife & Sons Co., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STANDPIPES, TANKS AND TOWERS
*Connery & Co., Inc., Philadelphia.
*N. Y. Central Iron Wks., Co., Inc., Hagerstown, Md.
W. E. Caldwell Co., Louisville, Ky.
Chatta. Blr. & Tank Co., Chatta, Tenn.
Chicago Bridge & Ir. Wks., Chicago
Lancaster Iron Wks., Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco.
Petroleum Ir. Wks. Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
United Iron Wks., Inc., K. City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STEAM SHOVELS (See Shovels, Steam)

STEAM TURBINES (See Turbines)

STEEL PLATE CONSTRUCTION
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Philadelphia.
*Heil Co., Milwaukee, Wis.
*Heltzel St. Form & Ir. Co., Warren, O.
*Jos. Honhort Co., Cincinnati, O.
*Littleford Bros., Cincinnati, O.
*N. Y. Central Iron Wks. Co., Inc., Hagerstown, Md.
Bethlehem Steel Co., Bethlehem, Pa.
Bigga Boiler Wks., Akron, O.
Birmingham Tank Co., Birmingham, Ala.
Chatta. Boiler & Tank Co., Chatta., Tenn.
Chicago Bridge & Iron Wks., Chicago.
Graver Corp., E. Chicago, Ind.
Hendrick Mfg. Co., Carbondale, Pa.
McClintic-Marshall Co., Pittsburgh, Pa.
Penna. Bridge Co., Beaver Falls, Pa.
Petroleum Iron Wks. Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
W. B. Scaife & Sons, Pittsburgh, Pa.
Toledo Crane Co., Toledo, O.
Union Iron Wks., Hoboken, N. J.
Walsh & Weidner Blr. Co., Chatta., Tenn.

STOKERS, MECHANICAL
Automatic Furnace Co., Dayton, O.
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N. Y.
Detroit Stoker Co., Detroit.
Sanford Riley Stoker Co., Worcester, Mass.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

STREET AND ROAD SIGNS (See Signs)

STREET CLEANERS CARTS
Durlach Can & Iron Wks., B'lyn, N. Y.
Rochester Can Co., Rochester, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N.Y.

STREET FLUSHERS AND SPRINKLERS
*Austin-Western Rd. Mchy. Co., Chicago.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*General Motors Trk. Co., Detroit, Mich.
*Heil Co., Milwaukee, Wis.
*Mack Trucks, Inc., N. Y.
Autocar Co., Ardmore, Pa.
E. D. Etnyre & Co., Oregon, Ill.
Federal Motor Truck Co., Detroit.
Chas. Hvass & Co., N. Y.
Kinney Mfg. Co., Boston
Municipal Supply Co., So. Bend, Ind.
White Co., Cleveland, O.

STREET LAMP POSTS
*Novo Engine Co., Lansing, Mich.
American Conc. Prod. Co., Chicago.
Chicago Conc. Post Co., Chicago.
J. B. Clow & Sons, Chicago.

Convinced — Of Jaeger Superiority!

RECENTLY we received a letter from a contractor who said, "Don't waste another two cents sending me descriptive folders. I'm convinced of Jaeger superiority and have two of your mixers now. I wanted your catalog to keep posted on your new models."

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Service That Never Fails

Jaeger Mixers "stand the gaff" of hardest working conditions and render unexcelled service for years. And our dealers and distributors are always close at hand where quick deliveries are easy.

The Jaeger Tilting-Drum, Tip-Over Water Tank, Power Loader and Gravity Discharge are labor saving devices found only in a Jaeger. Our line of 36 models means a complete mixing outfit for every purpose.

Let us send you our catalog and the name of our nearest dealer. You, also, should be well posted on the latest Jaeger development.

The Jaeger Machine Company

701 Dublin Ave. Columbus, Ohio

Jaeger "A MIX A MINUTE"

THE ORIGINAL JAEGER

Jaeger "A MIX A MINUTE"

TILTING-DRUM MIXER

Electric Ry. Equip. Co., Cincinnati, O.
King Mfg. Co., Chicago.
Union Metal Mfg. Co., Canton, O.
Westinghouse Elec. & Mfg. Co., E Pittsburgh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS
*Austin-Western Rd. Mchy. Co., Chicago.
*Good Rds. Mach. Co., Kennett Sq., Pa.
Butler Mfg. Co., Cleveland, O.
Elgin Sales Corp., N. Y.
Foamite-Childs Corp., Utica, N. Y.
Kinney Mfg. Co., Boston

STREET SWEEPING BROOMS
*Littleford Bros., Cincinnati, O.
J. I. Holcomb Mfg. Co., Indianapolis.
Ind. Brush & Broom Mfg. Co., Indianapolis, Ind.
Kendallville Broom & Brush Co., Kendallville, Ind.
Lang Broom Co., Pittsburgh, Pa.
Jos. Lay Co., Ridgeville, Ind.
Milwaukee Brush Mfg. Co., Milwaukee.
Osborn Mfg. Co., Cleveland, O.

STREET BROOMS REFILLED
Kendallville Broom & Brush Co., Kendallville, Ind.
Lang Broom Co., Pittsburgh, Pa.
Osborn Mfg. Co., Cleveland, O.

STUMP PULLERS
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
*John Waldron Corp., New Brunswick, N. J.
Ersted Machy. Mfg. Co., Portland, Ore.
H. L. Bennett & Co., Westerville, O.
Thomas Elevator Co., Chicago.

SUBGRADING MACHINES
*Lakewood Eng. Co., Cleveland, O.
The Hug Co., Highland, Ill.
Shaw-Enochs Tractor Co., Minneapolis

SUPERHEATERS
Babcock & Wilcox Co., N. Y.
Power Specialty Co., N. Y.
Superheater Co., N. Y.

SURVEYORS' INSTRUMENTS (See Instruments)

SWITCHBOARDS
Allis-Chalmers Mfg. Co., Milwaukee.
General Elec. Co., Schenectady, N. Y.
Wagner Elec. Mfg Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TAMPING MACHINES
*Harnischfeger Corp., Milwaukee, Wis.
*Ingersoll-Rand Co., N. Y.
Chicago Pneum. Tool Co., New York

TANKS, AIR COMPRESSOR
*Connery & Co., Inc., Philadelphia.
*Curtis Pneum. Mchy. Co., St. Louis, Mo.
*Heil Co., Milwaukee, Wis.
*Ingersoll-Rand Co., N. Y.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., N. Y.
Biggs Boiler Wks., Akron, O.
Birmingham Tank Co., Birmingham, Ala.
Chicago Bridge & Iron Wks., Chicago.
Chicago Pneum. Tool Co., N. Y.
Graver Corp., E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Wks. Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
W. B. Scaife & Sons Co., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.
Worthington Pump & Machy. Corp., N.Y.

TANKS, STEEL
*Connery & Co., Philadelphia.
*Heil Co., Milwaukee, Wis.
*Jos. Honhorst Co., Cincinnati, O.
*Littleford Bros., Cincinnati, O.
*N. Y. Central Irn. Wks. Co., Hagerstown, Md.
Biggs Boiler Wks., Akron, O.
Birmingham Tank Co., Birmingham, Ala.
S. F. Bowser & Co., Inc., Ft. Wayne, Ind
J. I. Case Threshing Mach. Co., Racine, Wis.
W. E. Caldwell Co., Louisville, Ky.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Wks., Chicago.
Columbian St. Tank Co., K. City, Mo.
Dover Boiler Wks., N. Y.
Farrell Mfg. Co., Joliet, Ill.
C. C. Fouts Co., Middletown, O.
Graver Corp., E. Chicago, Ind.
R. Hardesty Mfg. Co., Denver, Col.
Hendrick Mfg. Co., Carbondale, Pa.
Lancaster Iron Wks., Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco.
Petroleum Iron Wks. Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
W. B. Scaife & Sons, Oakmont, Pa.
United Iron Wks., Inc., K. City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.
Wayne Tank & Pump Co., Ft. Wayne, Ind

TANKS, WOOD
W. E. Caldwell Co., Louisville, Ky.
G. M. Davis & Son, Palatka, Fla.
Eagle Tank Co., Chicago.
Hauser-Stander Tank Co., Cincinnati, O.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
Nat'l Tank & Pipe Co., Portland, Ore.
Pacific Tank & Pipe Co., San Francisco.
Redwood Mfrs. Co., San Francisco.
A. T. Stearns Lumber Co., Boston.
U. S. Wind Eng. & Pump Co., Batavia, Ill.
Wendnagel & Co., Chicago.

TANK WAGONS
*Acme Rd. Mach. Co., Frankfort, N. Y.
*Galion Ir. Wks. & Mfg. Co., Galion, O.
*Heil Co., Milwaukee, Wis.
*Mack Trucks, Inc., N. Y.
Butler Mfg. Co., Minneapolis, Minn.
J. I. Case Threshing Mach. Co., Racine, Wis.

TAPES, STEEL AND METALLIC
*Lufkin Rule Co., Saginaw, Mich.
Eugene Dietzgen Co., N. Y.
Keuffel & Esser Co., Hoboken, N. J.
L. S. Starrett, Athol, Mass.

TAR
*Barrett Co., N. Y.
Amer. Tar Prod. Co., Pittsburgh, Pa.

TAR KETTLES (See Kettles)

THAWING OUTFITS
*Aeroil Burner Co., Union Hill, N. J.
*Hauck Mfg. Co., Bklyn, N. Y.

TIES, STEEL
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Int'l Steel Tie Co., Cleveland, O.
Sweet's Steel Co., Williamsport, Pa.

TIMBER CLAMPS
Pyle-Rogers Corp., N. Y.

TIRES, RUBBER (For Motor Trucks)
Firestone Tire & Rubber Co., Akron, O.
Fisk Tire Co., Chicopee Falls, Mass.
Goodrich Rubber Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., N. Y.
U. S. Tire Co., N. Y.

TOOL HOUSES, PORTABLE STEEL
*Blaw-Knox Co., Pittsburgh, Pa.
*Littleford Bros., Cincinnati, O.

TORCHES, OIL (HEATING)
*Chausse Oil Burner Co., Elkhart, Ind.
*Hauck Mfg. Co., Bklyn, N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Alex. Milburn Co., Baltimore, Md.

TOWERS (See Standpipe, Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE
*Easton Car & Constn. Co., Easton, Pa.
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Lakewood Eng. Co., Cleveland, O.
Atlas Car & Mfg. Co., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Fdry. & Mfg. Co., Columbus, O.
C. W. Hunt Co., Inc., W. N. Brighton, N. Y.
Sweet's Steel Co., Williamsport, Pa.

TRACTORS
*Caterpillar Tractor Co., San Leandro, Calif.
*Cleveland Tractor Co., Cleveland, O.
*Ford Motor Co., Detroit, Mich.
*Geo. Haiss Mfg. Co., New York
*Huber Mfg. Co., Marion, O.
*Mack Trucks, Inc., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Monarch Trac., Inc., Watertown, Wis.
Advance-Rumely Thresher Co., Laporte, Ind.
Allis-Chalmers Mfg. Co., Milwaukee
Bates Mach. & Tractor Co., Joliet, Ill.
Clark Tractractor Co., Buchanan, Mich.
Emerson-Brantingham, Rockford, Ill.
Hart-Parr Co., Charles City, Ia.
Int'l Harvester Co., Chicago.
J. T. Tractor Co., Cleveland, O.
Kinnard & Haines, Minneapolis, Minn.
John Lauson Co., New Holstein, Wis.
The Minneapolis Line, Minneapolis.
Shaw-Enochs Tractor Co., Minneapolis
Twin City Co., Minneapolis, Minn.

TRAFFIC LINE MARKERS
Carrara Paint Co., Cleveland, O.
Continental Prod. Co., Euclid, O.
Line-O-Graph Co., N. Y.
Tenn. Tool Wks., Inc., Knoxville, Tenn.

TRAFFIC PAINT
Carrara Paint Co., Cleveland, O.
Continental Prod. Co., Euclid, O.
Hanline Bros., Baltimore, Md.
Hoosier Paint Wks., Ft. Wayne, Ind.
Sowall Paint & Glass Co., K. City, Mo.
Sherwin-Williams Co., Cleveland, O.
Tropical Paint & Oil Co., Cleveland, O.
Truscon Laboratories, Detroit, Mich.
Wamble Paint & Varnish Works, Rochester, N. Y.

TRAFFIC SIGNS (See "Signs, Traffic")

TRAILERS FOR TRUCKS AND TRACTORS
*Eagle Wagon Wks., Auburn, N. Y.
*La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
*Miami Trailer-Scraper Co., Troy, O.
*Watson Truck Corpn., Canastota, N. Y.
Arcadia Trailer Corp., Newark, N. Y.
Detroit Trailer & Mach. Co., Detroit.
Hercules Trailer Mfg. Co., Los Angeles
Highway Trailer Co., Edgerton, Wis.
Lee Trailer & Body Co., Chicago.
Squier-Rix Co., Milwaukee, Wis.
Troy Wagon Wks., Troy, O.
Warner Mfg. Co., Beloit, Wis.
Whitehead & Kales Co., Detroit, Mich.

TRAILERS, INDUSTRIAL
*Lakewood Eng. Co., Cleveland, O.
*La Plant Choate Mfg. Co., Cedar Rapids, Ia.
Chase Fdry. & Mfg. Co., Columbus, O.
Detroit Trailer & Mach. Co., Detroit.
Electric Wheel Co., Quincy, Ill.

Lee Trailer & Body Co., Chicago.
Whitehead & Kales, Detroit, Mich.

TRAMWAYS, AERIAL WIRE ROPE
*Street Bros. Mach. Wks., Chattanooga
Broderick & Bascom Rope Co., St. Louis, Mo.
A. Leschen & Sons Rope Co., St. Louis.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee.
Duncan Elec. Mfg. Co., Lafayette, Ind.
Enterprise Elec. Co., Warren, O.
General Elec. Co., Schenectady, N. Y.
Kuhlman Elec. Co., Bay City, Mich.
Maloney Elec. Co., St. Louis, Mo.
Packard Elec. Co., Warren, O.
Pittsburgh Transf. Co., Pittsburgh, Pa.
Wagner Elec. Corp., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TRANSITS AND LEVELS (See Instruments)

TRANSMISSION (Auxiliary for Fords)
*Fuller & Sons Mfg. Co., Kalamazoo, Mich.
*Hinkley Motors, Inc., Detroit
H. McFarlane & Co., Chicago.
Ruckstell Sales & Mfg. Co., N. Y.
Warford Corpn., N. Y.

TRANSMISSION MACHINERY, POWER
Allis-Chalmers Mfg. Co., Milwaukee.
Chain Belt Co., Milwaukee, Wis.
Dodge Mfg. Corpn., Mishawaka, Ind.
Link-Belt Co., Chicago.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.

TRASH CANS (See Cans)

TREADS, SAFETY
Amer. Abrasive Metals Co., N. Y.
Amer. Mason Safety Tread Co., Lowell, Mass.
Concrete Steel Co., N. Y.
Norton Co., Worcester, Mass.

TRENCH EXCAVATORS (See Excavators)

TRENCH PUMPS (See Pumps, Contractors')

TURBINES
*Ingersoll-Rand Co., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee.
De Laval Steam Turbine Co., Trenton, N. J.
General Elec. Co., Schenectady, N. Y.
Terry Steam Turb. Co., Hartford, Ct.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TURNTABLES FOR MOTOR TRUCKS
*Blaw-Knox Co., Pittsburgh, Pa.
*Easton Car & Const. Co., Easton, Pa.
Champion Eng. Co., Kenton, O.
Freeman Mfg. Co., Racine, Wis.
Hug Co., Highland, Ill.
Western Structural Co., Moline, Ill.

VALVES, ACID RESISTING
*Barber Asphalt Co., Philadelphia

VALVES, CHECK
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston.
Ludlow Valve Mfg. Co., Troy, N. Y.
Mich. Valve & Fdry. Co., Detroit.
Rensselaer Valve Co., Troy, N. Y.

VALVES, GATE AND INDICATOR POSTS
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston.
Columbian Ir. Wks., Chattanooga, Tenn.
Crane Company, Chicago.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., N. Y.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Rensselaer Valve Co., Troy, N. Y.
A. P. Smith Mfg. Co., E. Orange, N.J.
R. D. Wood & Co., Philadelphia.

VALVES, PRESSURE SEATED
Cleveland Pneum. Tool Co., Cleveland, Ohio.

VALVE BOXES AND HOUSINGS
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
Central Fdry. Co., N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
H. W. Clark Co., Mattoon, Ill.
J. B. Clow & Sons, Chicago.
Columbian Ir. Wks., Chattanooga, Tenn.
Darling Valve & Mfg. Co., W'msport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., N. Y.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
H. Mueller Mfg. Co., Decatur, Ill.
Rensselaer Valve Co., Troy, N. Y.
A. P. Smith Mfg. Co., E. Orange, N. J.
R. D. Wood & Co., Philadelphia

WAGONS (See Dump Carts and Wagons)

WAGON BODIES (See Dump Bodies)

WAGON LOADERS (See Loaders, Gravel and Wagon)

WALLBOARD
Beaver Prod. Co., Inc., Buffalo, N. Y.
Bird & Son, Inc., E. Walpole, Mass.
Cornell Wood Prod. Co., Chicago.
Haverhill Box Board Co., Haverhill, Mass.
MacAndrews & Forbes Co., N. Y.
Plastergon Wall Board Co., Buffalo, N.Y.
U. S. Gypsum Co., Chicago.
Upson Co., Lockport, N. Y.
Waldorf Paper Prod. Co., St. Paul, Minn

WALL TIES
Concrete Steel Co., N. Y.
Consolidated Exp. Metal Co., Braddock, Pa.
Berger Mfg. Co., Canton, O.
Milwaukee Corr. Co., Milwaukee, Wis.
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

WATER MAIN CLEANING
Nat'l Water Main Cleaning Co., N. Y.

WATER MAIN TAPPING MACHINES
Hays Mfg. Co., Erie, Pa.
H. Mueller Mfg. Co., Decatur, Ill.
A. P. Smith Mfg. Co., E. Orange, N. J.

WATER METERS (See Meters, Water)

WATERPROOFING COMPOUNDS AND MATERIAL
*Barber Asphalt Co., Philadelphia.
*Barrett Company, N. Y.
*Philip Carey Co., Cincinnati, O.
*Standard Oil Co. (Indiana), Chicago
*Texas Company, N. Y.
Atlantic Refining & Asphalt Corp., Phil'a
General Firep'f'g Co., Youngstown, O.
Master Builders' Co., Cleveland, O.
Minwax Co., N. Y.
Protexol Corpn., N. Y.
Ruberoid Co., N. Y.
Sandusky Cement Co., Cleveland, O.
Sonneborn Sons, Inc., N. Y.
Toch Brothers, N. Y.
Truscon Laboratories, Detroit, Mich.

WATER PURIFICATION (See also Filters)
*Wallace & Tiernan Co., Inc., Newark, N.J.
Paradon Eng. Co., L. I. City, N. Y.
R. U. V. Co., N. Y.

WATER PURIFICATION CHEMICALS
Arnold Hoffman & Co., Inc., N. Y.
E. I. Du Pont de Nemours & Co., Wilmington, Del.
Electro Bleaching Gas Co., N. Y.
General Chemical Co., N. Y.
Hooker Electrochemical Co., N. Y.
Mathieson Alkali Works, Inc., N. Y.
Penna. Salt Mfg. Co., Philadelphia

WATER SOFTENERS
Amer. Water Softener Co., Philadelphia.
Cochrane Corp., Philadelphia.
Graver Corp., E. Chicago, Ind.
Int'l Filter Co., Chicago.
Permutit Co., N. Y.
Power Plant Spec. Co., Chicago.
W. B. Scaife & Sons, Pittsburgh, Pa.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

WATER WASTE DETECTION
*Pitometer Co., N. Y.
Empire Elec. & Water Co., Inc., N. Y.
Simplex Valve & Meter Co., Phil'a.

WATER WHEELS
Allis-Chalmers Mfg. Co., Milwaukee.
Wm. Cramp & Sons Ship & Eng. Bldg. Co., (I. P. Morris Dept.) Phil'a.
J. Leffel & Co., Springfield, O.
Newport News Shipbldg. & Dry Dock Co., Newport News, Va.
Pelton Water Wheel Co., San Francisco.
S. Morgan Smith Co., York, Pa.
Worthington Pump & Mchy. Corp., N.Y.

WATER WORKS PUMPS (See Pumps)

WELDING APPARATUS
*Alex. Milburn Co., Baltimore, Md.
Burke Elec. Co., Erie, Pa.
General Elec. Co., Schenectady, N. Y.
Lincoln Elec. Co., Cleveland, O.
Oxweld Acetylene Co., L. I. City, N. Y.
Smith's Inventions, Inc., Minneapolis, Minn.
U. S. Light & Heat Corp., Niagara Falls.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

WELL SCREENS
A. D. Cook, Inc., Lawrenceburg, Ind.
E. E. Johnson, Inc., St. Paul, Minn.

WELLS, CONCRETE
Kelly Well Co., Grand Island, Neb.

WELL-DRILLING AND BLAST HOLE MACHINES
*Keystone Driller Co., Beaver Falls, Pa.
Armstrong Mfg. Co., Waterloo, Ia.
Loomis Mach. Co., Tiffin, O.
Sanderson Cyclone Drill Co., Orrville, O
Star Drilling Mach. Co., Akron, O.

WHEELBARROWS
*Akron Barrow Co., Cleveland, O.
*Jackson Mfg. Co., Harrisburg, Pa.
*Lansing Co., Lansing, Mich.
*Toledo Wheelbarrow Co., Toledo, O.
Asheboro Wheelbarrow Co., Asheboro, N. Carolina.
Chattanooga Wheelbarrow Co., Chattanooga, Tenn.
Cleveland Wheelbarrow Co., Cleveland, O.
Fairbanks Co., N. Y.
Puffer-Hubbard Mfg. Co., Minneapolis.
Sidney Steel Scraper Co., Sidney, O.
Sterling Wheelbarrow Co., Milwaukee.

WINCHES
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mch. Co., Niagara Falls.
*Lidgerwood Mfg. Co., N. Y.
*Mundy Sales Corp., N. Y.
*Street Bros. Mach. Wks., Chattanooga
Bethlehem Shipbldg. Corp., Bethlehem, Pa.

Chisholm-Moore Mfg. Co., Cleveland, O.
Dake Eng. Co., Grand Haven, Mich.
Erated Machy. Mfg. Co., Portland, Ore.
Mead-Morrison Mfg. Co., E. Boston

WINDOW FRAMES AND SASH (Metallic)
*Truscon Steel Co, Youngstown, O.
Wm. Bayley Co., Springfield, O.
Detroit Steel Prod. Co., Detroit.
E. H. Friedrick Co., Holyoke, Mass.
David Lupton's Sons Co., Philadelphia
Penn Metal Co., Boston.
Sykes Co., Chicago.

WIRE AND CABLE
*Williamsport Wire Rope Co., Williamsport, Pa.
American Cable Co., N. Y.
Amer. Steel & Wire Co., Chicago.
Copperweld Steel Co., Braddock P. O., Rankin, Pa.
Fischer & Hayes Rope & St. Co., Chicago
General Elec. Co., Schenectady, N. Y.
Habirshaw Elec. Cable Co., Inc., N. Y.
Hazard Mfg. Co., Wilkesbarre, Pa.
Macwhyte Co., Kenosha, Wis.
Nat'l India Rubber Co., Bristol, R. I.
N. Y. Insulated Wire Co., N. Y.
Okonite Co., Passaic, N. J.
J. A. Roebling's Sons Co, Trenton, N.J.
Safety Ins. Wire & Cable Co., N. Y.
Simplex Wire & Cable Co., Boston.
Standard Underground Cable Co., Pittsburgh, Pa.
Tubular Woven Fabric Co., Pawtucket, R. I.
Waterbury Co., N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE GLASS
Mississippi Wire Glass Co., N. Y.

WIRE MESH REINFORCEMENT
*Truscon Steel Co., Youngstown, O.
Amer. Stl. & Wire Co., Chicago
Nat'l Stl. Fabric Co., Pittsburgh, Pa.
Wickwire Spencer Steel Co., N. Y.

WIRE ROPE (See Rope, Wire)

WOOD BLOCKS (See Paving Blocks)

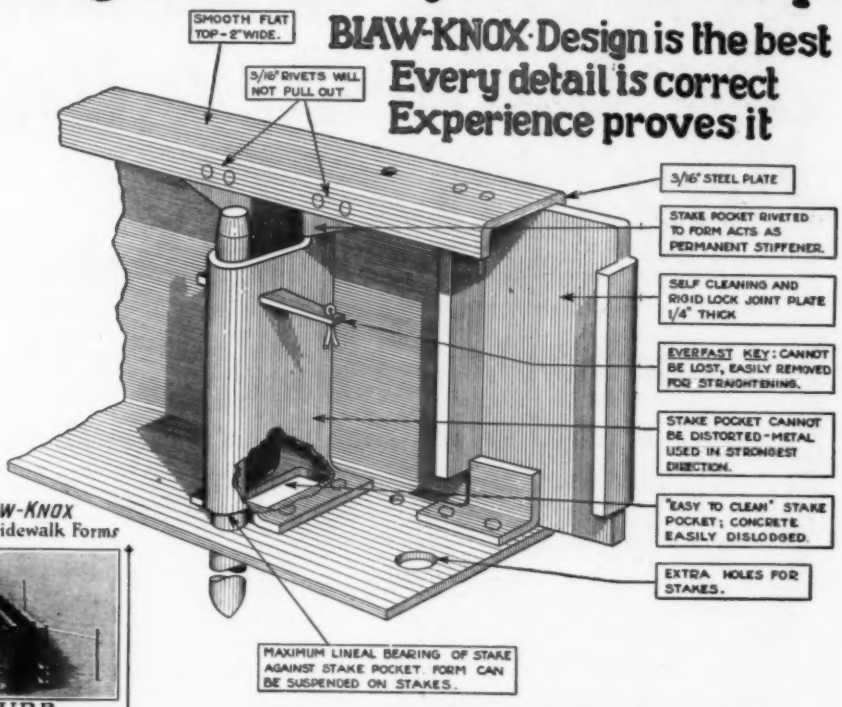
WOODWORKING MACHINES
*Amer. Saw Mill Mach. Co., Hackettstown, N. J.
*Ransome Conc. Mchy. Co., Dunellen, N.J.
Fairbanks, Morse & Co., Chicago.
Jones Superior Mach. Co., Chicago.

WOOD PRESERVATIVES
*Barrett Co., N. Y.
Protexol Corpn., N. Y.

WRENCHES
Snap-On Wrench Co., Chicago.

Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

The Eighth Year of Leadership



BLAW-KNOX Design is the best
Every detail is correct
Experience proves it

BLAW-KNOX
Street & Sidewalk Forms

CURB


CURB AND GUTTER


SIDEWALKS

BLAW-KNOX PRODUCTS
Batcherplants for
Batchers for
Inundation System
Steel Forms for
Clamshell Buckets
Turntables
Steel Buildings

WHY TAKE A CHANCE?

Through seven successful seasons on thousands of road jobs, the Blaw-Knox Road Form has adhered to and today retains its original principles of design.

THE STAKING SYSTEM
THE LOCK JOINT
THE THREE POINT REINFORCEMENT
THE RIVETED CONSTRUCTION

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The Broadmoor-Cheyenne Mountain Highway

By C. H. Bryson
Chief Engineer

THE eastern slope of Cheyenne Mountain, upon which practically all of the Broadmoor-Cheyenne Mountain Highway is constructed, and which is owned by the Cheyenne Mountain Company, presented considerably more of a problem in high location and construction than the western slope, of which the greater part is in the Pike National Forest. The eastern slope is very steep and rugged, with numerous high cliffs and boulder fields; the western slopes are more gentle, with less timber and considerably more granite in a disintegrated state.

Cheyenne the Next of Kin to Pike's Peak

Cheyenne Mountain, while not one of the major peaks of Colorado, is unique in several ways: it rises sheer from the plains without the preliminaries of foothills; the view from its summit of both plains country and high mountain ranges is unexcelled; its base circumference is the second largest of any of the Colorado mountains; and it is in the back dooryard of Broadmoor, the beautiful residential suburb of Colorado Springs. Cheyenne Mountain also happens to be the one from whose summit Lieutenant Zebulon Pike, on a side excursion from his exploration of the Arkansas Valley in 1806, viewed in the distance the mountain afterwards called Pike's Peak and declared that it would never be scaled by man.

There exists a very good United States Geological Survey topographic sheet of this section with a contour interval of 50 feet and to a scale of about 2,000 feet to the inch. Before starting the location survey several photostat enlargements of this map were secured, enlarging the scale to about 1,000 feet to the inch, and proving invaluable during the location survey in determining the location of the swings and later during the design for computing watershed areas above the culverts.

Preliminary Surveys

The location survey was started in November, 1923, by the writer with a level rodman and an axeman, the rodman and axeman also serving as chainmen. As it had been decided previously that the gradient of the complete highway must not exceed 10 per cent in any place and that the average gradient should not exceed 8 per cent, an 8 per cent grade contour line was developed, allowance being made for the shortening of the line across draws and around points and also for the flattening of the grade around swings and the sharpest of the curves. Temporary stakes were set with a wye level on this grade contour line at intervals of 50 feet or less, and bench-marks, railroad spikes in blazed trees, at intervals of about 800 feet. After this location line was sufficiently advanced, a cross-section crew of two men was started, taking hand level cross-sections at each stake for a

distance of about 50 feet on either side of the line. The progress of the location party was from 500 to 1,200 feet per day, and of the cross-section party from 1,000 to 2,000 feet per day, depending upon snow conditions, the number of cliffs encountered, and the amount of timber and brush to be cut out. The preliminary location and cross-sections were completed in the latter part of January, 1924, and a transit survey of the preliminary line was started shortly afterward.

The Transit Survey

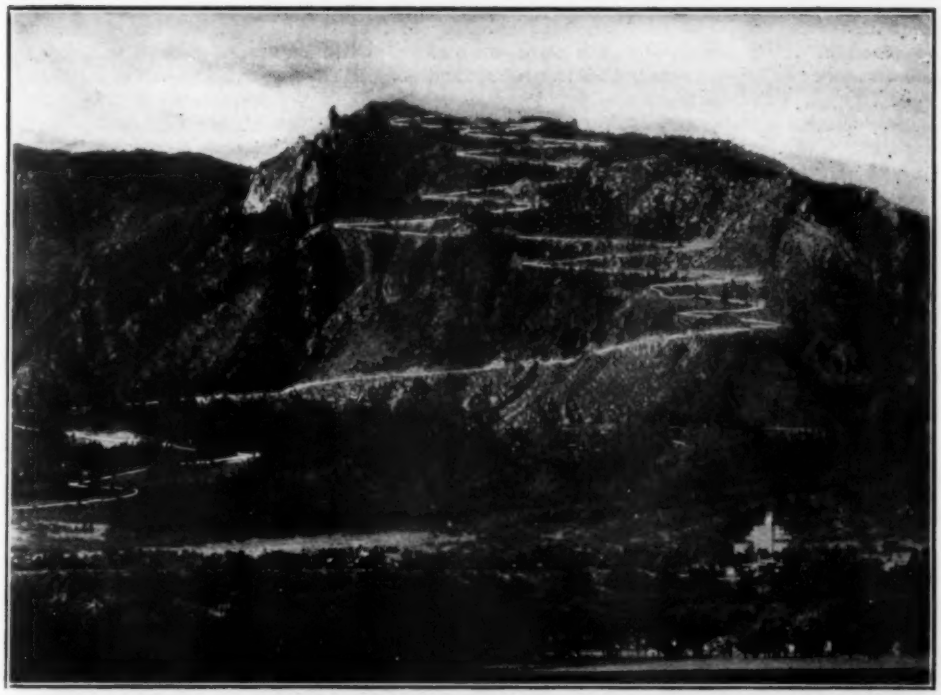
On the transit survey all section corner monuments in the lower country, having been flagged beforehand, were kept tied into the line all of the way to the summit. Stadia surveys were made of all swing locations and at numerous other points along the line where the location was difficult. These were later plotted on a scale of 1 inch equals 20 feet, with a contour interval of 2 feet. Concurrently with the progress of the transit survey, which was from 1,000 to 1,500 feet per day, a draftsman in the office kept all field notes plotted so that upon the completion of the transit survey, in April, 1924, we had the entire line plotted on a scale of 1 inch equals 100 feet, and the cross-sections to a scale of 1 inch equals 10 feet. There was considerable snow during the winter of 1923-24 and the greater part of the transit survey near the summit was made in snow almost waist deep.

Roadway sections were next plotted on the cross-sections from templates made to the scale of the cross-section and with ½ to 1 cut slopes and 1¼ to 1 embankment slopes for rock, and 1 to 1 cut slopes and 1½ to 1 embankment slopes for disintegrated rock or common. These templates were shifted to the right or left on the cross-sections sufficiently to make a balanced section wherever practicable, and the distance to the right or left plotted on the alignment drawings. In establishing the center line alignment it was kept as near as practicable to the points to the right or left of the preliminary line, which gave a balanced section. This was also kept in mind in establishing the center line grade on the profile. It was first decided to make the radii of the swings 40 feet and to have the minimum radii on the line between swings 100 feet, but the very steep slopes of the mountain and the large amount of rock involved (some of the swings with a 40-foot radius ran into about 18,000 cubic yards of solid rock excavation) made necessary a change on the heaviest of the swings to 30-foot radii, and at some points on the line between swings to 75-foot radii.

Specifications and Plans for Bids

Plans consisting of eight sheets, the first being the geography of the immediate country on a scale of 1 inch equals 400 feet, the second the details of the structures, including retaining walls, culverts, and culvert head walls, typical sections of the different types of roadway, etc., and the remaining six sheets a detailed plan and profile of each mile, were prepared, specifications written, and bids called for on August 15, 1924. Bids were asked on clearing and grubbing per acre, on excavation, solid rock and common per cubic yard, borrow fill, both solid and common, per cubic yard, overhaul per station

SPIRAL SHELVES, AN APPARENT MYSTIC MAZE ON THE BROADMOOR-CHEYENNE MOUNTAIN HIGHWAY



A GENERAL VIEW OF THE BROADMOOR-CHEYENNE MOUNTAIN HIGHWAY, SHOWING SOME OF ITS NUMEROUS CURVES

yard, corrugated iron pipe culverts from 12-inch to 36-inch, per linear foot, dry rubble masonry per cubic yard, timber cribbing per linear foot in 3-, 4- and 5-foot heights, and disintegrated granite surfacing per square yard. Bids were received from six different contracting firms and, a few days later, were rejected as being too high, but more particularly because not one of the responsible contractors made any distinction in his bid price between solid rock and common excavation.

After bids were rejected, it was decided that with the purchase of a steam shovel, air-compressors, rock drills, steel sharpener, and miscellaneous small equipment, together with available equipment used in the maintenance of the Pike's Peak Auto Highway, which included several White dump-body motor trucks, a 60-h. p. Caterpillar tractor, an Austin Rip Snorter road grader, etc., the company proceed with the work by day labor crews, contracting only the heaviest portions of the work, which must necessarily be done by hand crews.

Construction Begun

On September 1, 1924, a crew of men with teams and tractor were started clearing and grubbing, and on September 10 an Osgood 1-cubic-yard steam shovel with crawler traction started excavation at the beginning of mile one. At about the same time work was started on the 1,600-foot section in the second mile, which was practically all rock work with heavy cuts and some high retaining walls and included the excavation of about 28,000 cubic yards of solid rock excavation and the construction of about 3,200 cubic yards of dry rubble masonry foundations to the roadway grade. This rock work was divided into three station contracts, the first two 400 feet long each, and the third 800 feet long. It was agreed to furnish these station contractors with powder at cost and compressed air and the use of drills and steel-sharpening service at a nominal cost. Incidentally, the station contractors' bid prices were only a little more than half of our lowest unit bids on the general contract. Work was started, a few days prior to the starting of work on the station contracts, on the installation of a 450-cubic-foot capacity steam-driven Norwalk air-compressor from which air was piped through a 4-inch main to the station contractors within 30 days after their starting work. This 4-inch air line from the central plant at the base of the mountain was later extended to

near the summit, and 2-inch laterals were laid to cover the entire work. The rock work in the first mile, which was mostly boulders, was drilled by air furnished by a Chicago Pneumatic portable compressor, 210 cubic feet capacity, which was later used in finishing and also as a booster on the main 4-inch line.

The station contractors had sufficiently advanced their work by December 1 to allow the steam shovel to pass over and start work on the other side. While not all heavy work, the greater part of the work from this point to the summit was heavy, with considerable solid rock and several boulder fields and rock slides to cross. This work was all done by the steam shovel except one 400-foot reach of rock cut in the third mile and two of the heaviest swings, which were all in solid rock coyote tunnels, and shot all heavy cuts and swings, and in a few instances in rock ledges and boulder fields practically had to build the road ahead of the steam shovel. The steam shovel reached the summit during the latter part of July, 1925.

Finishing and Surfacing the Road

Finishing and surfacing followed the steam shovel and was done with hand crews, teams and Western scrapers and tractor and road grader. The finishing crew on the greater part of the work used the portable air-compressor to furnish air for drilling. Surfacing was not a problem, for practically all of the mountain that is not solid rock is disintegrated granite. which, mixed with a little soil, as it usually is, makes an ideal surfacing material.

A SCENIC POINT KNOWN AS BOND POINT SWING

and were contracted. The 400-foot contract had center line cuts of from 5 to 25 feet, and, being almost directly over the station work in the second mile, had to be all done by hand and the excavated muck trammed to the ends of the cut and wasted. The total excavation in this contract amounted to 7,500 cubic yards. which was about 90 per cent solid rock, and was contracted for $1.10 per cubic yard unclassified, air and drill furnished free to the contractor, powder at cost. Swings 12 and 13 were contracted at the same price, with an additional price of $3 per cubic yard for dry rubble masonry retaining wall, of which there was 900 cubic yards. Preceding the steam shovel was a clearing gang, which, of course, was farthest in advance, and a drilling and hand crew which drilled and shot all boulders, laid up retaining walls, drove

Stakes were set ahead of the steam shovel, and station contractors on center line at 50-foot intervals on tangent, and on curves at intervals of about 25 feet. These were profiled and cuts or fills marked on the stakes to finish grade. From the center line stakes, top-of-slope and toe-of-embankment stakes were set with hand level and rod, and a reference stake giving the cut and distance to the completed center line was set, usually 10 feet back of the top of slope stakes. All tangent intersections and centers of swings were referenced two ways to facilitate re-staking, which very often had to be done two to three times.

After finishing and surfacing work had started and the portable air-compressor was removed from the vicinity of the steam shovel, a heavy-duty locomotive air-compressor was mounted on the rear of the steam

shovel, taking its steam supply from the shovel boiler, and a small Westinghouse locomotive type air receiver on the roof, and an Ingersoll-Rand drill and supply of drill steel carried along. This drilling outfit was used when the shovel encountered large boulders missed by the drilling crew. When in deep cuts, and the toe of the cut had tightened or an imbedded boulder was encountered, it took but a few minutes to stop, drill a hole, and shoot.

The lack of water on the mountain was one of the serious handicaps in the construction of the highway and, I think, one of the reasons that the contractors' bids were so high. It was on account of the lack of water that it was decided to use no concrete and to construct all of the retaining walls of dry rubble. For the first mile and a half of the work all of the steam shovel boiler water was trucked from the foot of the mountain. Above this point a C. H. & E. triplex gasoline-driven pumping-engine, good for an 800-foot lift, was installed at the foot of the mountain near the air-compressor plant and pumping through a 2-inch line to tanks kept not far distant from the steam shovel. Later, when the steam shovel was beyond the limit of this pump, a duplicate was installed, along the highway, taking suction from a tank into which the first pump discharged, and pumping to within a short haul of the summit of the mountain. No teams were used except with the finishing crew, all of the fills being made by 5-ton dump-body motor trucks.

Despite the fact that there were 140,000 pounds of powder, most of which was Du Pont 40 per cent gelatin dynamite, used on the work, and that the danger from rolling rock was great on account of the number of elevations of road below, there were no fatal accidents on the work. On one occasion the steam shovel dug into a missed powder pocket containing about 700 pounds of powder, causing a blast which stripped the shovel bare of cab, overturned it and injured the operator and fireman severely enough to force them to remain in the hospital for almost a month.

The total length of the highway is 7 miles, which includes about ¼-mile of old road which was widened, with permanent culverts installed, and the alignment improved. The starting elevation of the highway is at 6,500 feet, and the elevation of the parking area at the summit is 9,130 feet. The average grade is slightly more than 7 per cent and the maximum, for very short reaches only, 10 per cent. There are 234 curves, of which 22 are swings. The grade is compensated on all curves of less than 200 feet radius, and around the center line of the swings is only 3 to 3½ per cent. The width of the highway varies from 20 to 40 feet, which includes the 2-foot-wide side ditch on the upper side. The crown or slope toward the inside is ½-inch to the foot, except on the swings, where it is ¼-inch to the foot. Retaining-wall sections and other seemingly dangerous points are protected with a Cyclone highway wire mesh fence supported by railroad rails imbedded 6 feet in the retaining walls or embankments. The work involved the moving of about 310,000 cubic yards of solid and disintegrated granite excavation and the construction of about 15,000 cubic yards of dry rubble masonry retaining wall, about 4,000 yards of which were used as toe walls at the toe of embankments, where the slope was only slightly steeper than the embankment slope. The total cost of the work, including engineering, legal expense, guard-rail and fence and miscellaneous, but not including the cost of the toll-gate house and summit house, was $260,000. A Pueblo Indian style toll-gate house of the same style is now under construction at the summit and is estimated to cot $75,000.

Ben Wreath served as Construction Superintendent for the company during the period of construction. The writer was Chief Engineer of location and construction, with H. Perry and K. H. Stealy, Assistant Engineers.

Book Review

1926 HAND BOOK FOR SAND, GRAVEL, STONE, CEMENT, GYPSUM AND LIME INDUSTRIES
By H. W. Monday, Editor, and various authors. Complete Service Publishing Co., Chicago, Ill. 1926. 576 pp. Illustrations, diagrams and tables. $5.00.

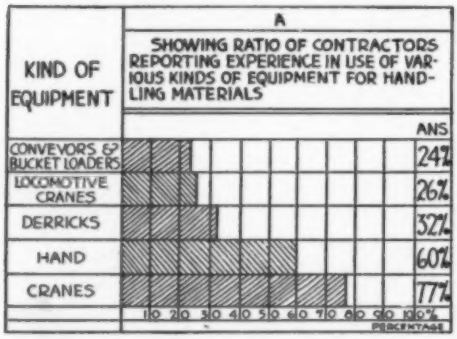
The 1926 edition of the Pit and Quarry Hand Book for the non-metallic mineral industries is a well-prepared reference volume with alternating sections of editorial material and advertising. It represents the combined work of a dozen specialists in cooperation with H. W. Munday, the Editor. It is divided into 30 sections, some of the more important of which are: Geology, Clinker Handling, by E. D. Roberts; Drilling and Blasting, Accident Prevention, by R. N. Van Winkle; Crushing, Grinding and Pulverizing, Elevating and Conveying, Storing and Miscellaneous Handling, Burning, Waste Heat Recovery, by C. H. Sonntag; Stripping, Loading and Transporting, Dredging, Pumping, Hydraulic Stripping, Power Transmission, by G. B. Massey; Power Screening and Separating, Washing and Drying, by H. W. Munday; Hydration of Lime, by H. S. Owen; Lubrication, Fire Prevention, Insurance, by Dwight Ingram; and Cost Accounting, by D. J. Hutchinson. This book is published primarily for use within the non-metallic mineral industries, which consist principally of cement, lime, gypsum, crushed stone, sand and gravel.

Relative Merits of Different Methods of Yard Handling of Materials

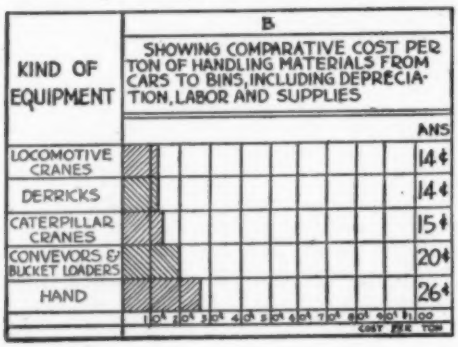
By Robert Petersen
Henry W. Horst Company, Rock Island, Ill.

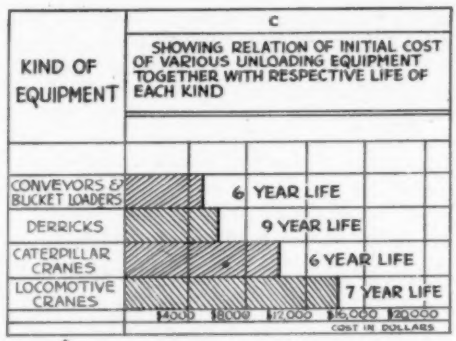
IN approaching this subject, it is natural to cast about for information, data, and facts from which to develop an idea. Through the courtesies of the manufacturers of equipment and answers to questionnaires received from a good many contractors throughout the country, it has been my privilege to gather a fund of information which I shall endeavor to present in as brief and concise a form as possible.

My first reaction from the reports received



from contractors was one of surprise that they gave the information asked for as freely as they did, and with apparent interest shown in the final outcome. True, there were some letters which conveyed the impression that it would be impossible to furnish any information that would be of benefit to anybody for all conditions. Others hesitated to attempt to make statements as to costs or methods used in their operations, but the majority of those

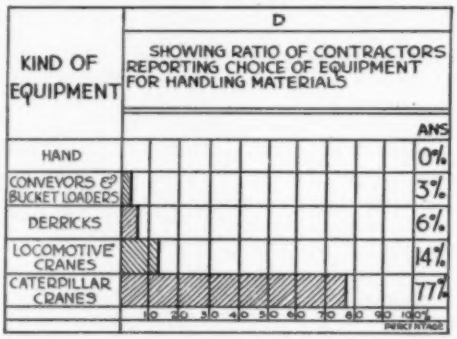




responding gave the best they had, and all were necessary to the whole picture.

Types of Equipment

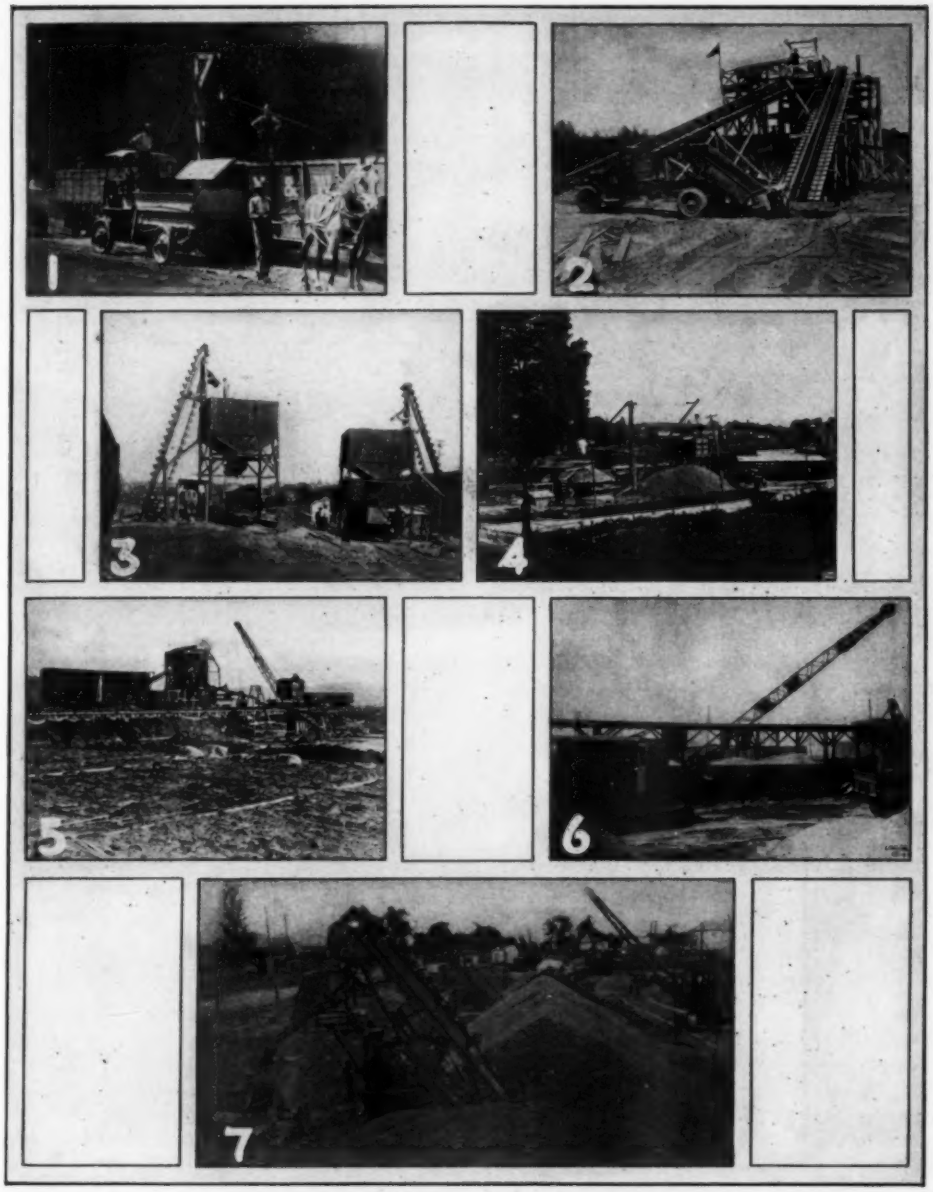
The various types of equipment used for unloading purposes can be briefly summarized as follows: hand unloading; belt and bucket



conveyors; derricks, stiff-leg and full-circle; locomotive cranes; crawler cranes; bucket loaders.

All these types of equipment, excepting the bucket loaders, are supplemented by some kind of unloading bin with proportioning hoppers. With the equipment described above, material can be handled satisfactorily from the cars to the stock piles or to the bins from whence it is proportioned and passes on to further job operation.

Chart A shows the ratio of contractors reporting their experience in use of various kinds of equipment for the handling of materials.

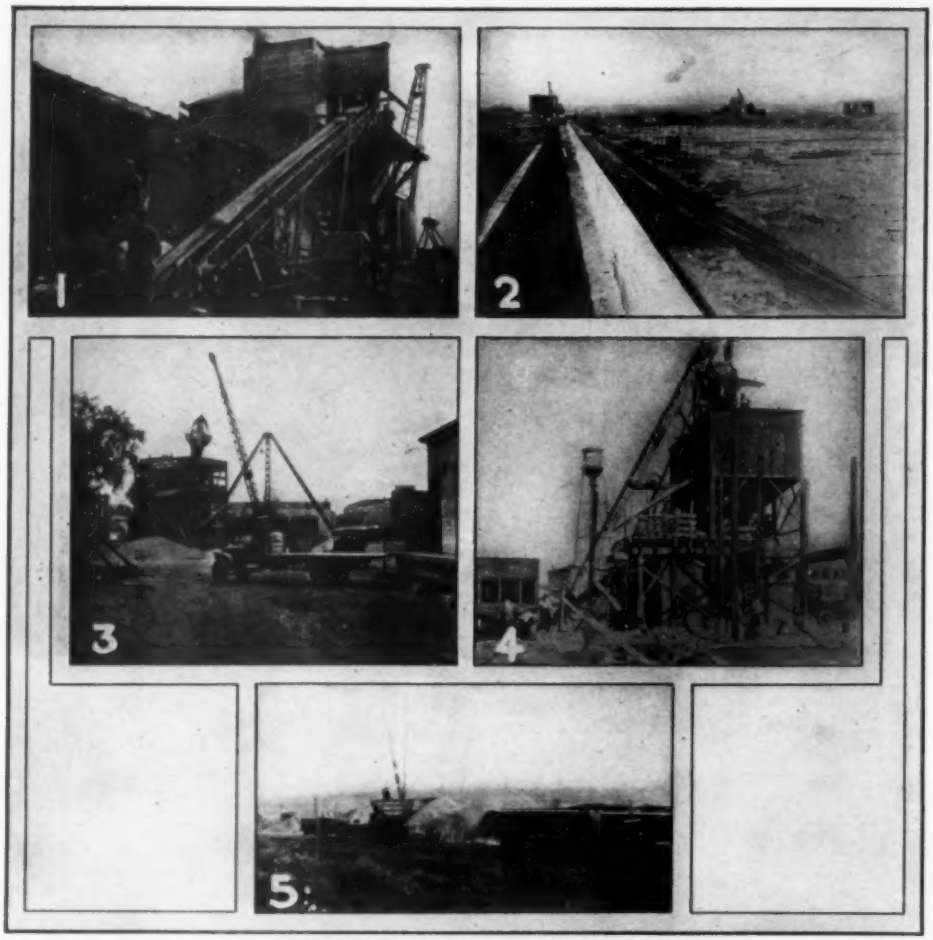


UNLOADING METHODS IN COMMON USE

1. Hand unloading. 2. Belt conveyors. 3. Bucket conveyors. 4. Stiff-leg derricks. 5. Locomotive cranes. 6. Crawler cranes. 7. Bucket loaders

The experience shown in this chart is that 77 per cent of the contractors have used cranes of various types; 60 per cent have used hand unloading methods; 32 per cent have had experience with derricks; 26 per cent have used locomotive cranes; and 24 per cent have used conveyors and bucket loaders.

Chart C shows the relation of initial cost of various unloading equipment together with the respective life of each kind. From it we learn that the reported average initial cost and the estimated respective life of each kind of equip-



EQUIPMENT CHOSEN TO FIT THE JOB

1. Belt conveyor for cement. 2. Locomotive cranes at central mixing plant. 3. Stiff-leg derrick with electric hoist. 4. Bucket unloader. 5. Full-circle electric derrick

ment is as follows: locomotive crane, $14 000, 7 years; crawler crane, $10,000, 6 years; derrick, $5,000, 9 years; conveyors and bucket unloaders, $4,500, 6 years. Attention is directed to the low initial cost of the cranes, together with their shorter period of usefulness.

The second group of pictures show that the choice of equipment depends upon the nature of the job and the physical conditions surrounding the plant site.

Illustration 1 shows a method of handling cement from the cars direct to the charging platform of a portable central mixing plant. Illustration 2 shows locomotive cranes used in connection with a portable central mixing plant. It is difficult to conceive of any other type of equipment that would satisfy the physical conditions of this plant site. Illustration 3 shows a stiff-leg derrick set up with an electric hoist, all confined in a rather cramped space. This type of equipment was chosen because of a city ordinance which prohibited the use of steam and made electric operation necessary. The contractor had this equipment available for use, therefore the choice. Illustration 4 shows the economical use of a bucket unloader. The extreme height of the bins feeding the central mixing plant in this set-up could not very well be served by a crane or derrick operation, and the contractor's choice of equipment for handling the materials from cars to bins becomes a point showing good judgment.

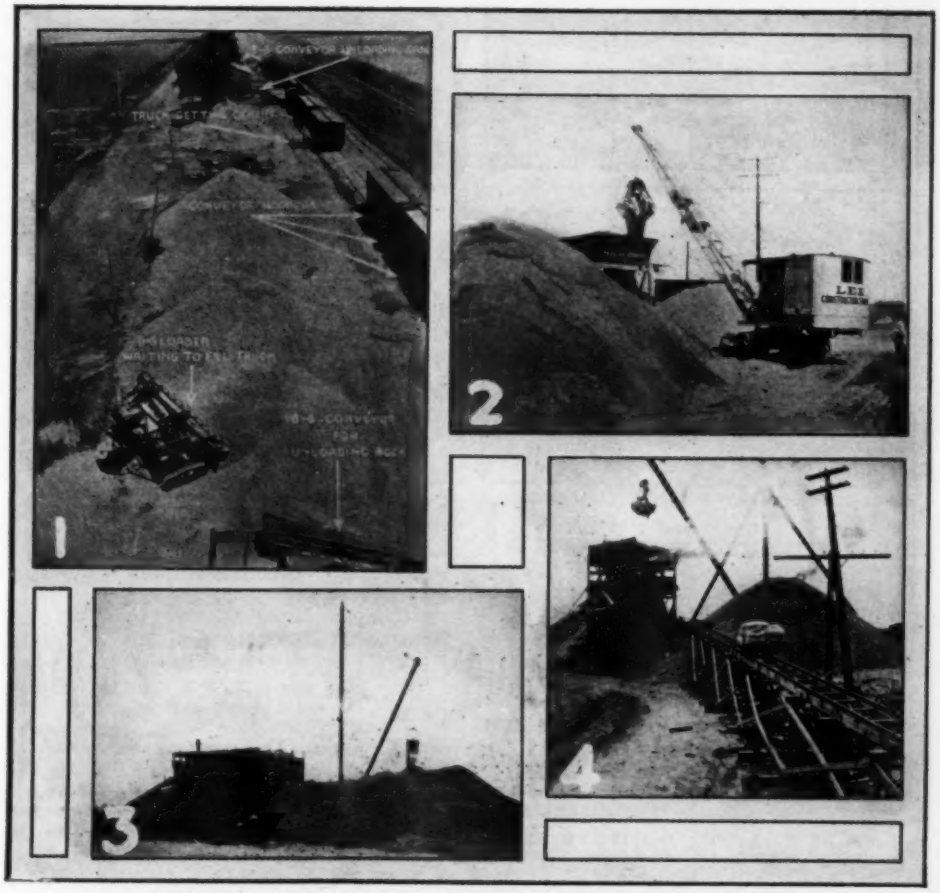
Illustration 5 shows a full-circle electric derrick used on a paving operation where electric power was available at a cheap rate. The plant site favored the set-up in that the bank on which the derrick was erected increased the storage capacity, which could not have been accomplished with a crane in this particular case, nor with conveyors or bucket unloaders. Storage on this job was of prime importance in that it enabled the contractor to buy and stock up materials at a reduced cost early in the season when other contractors were not taking material.

Chart B shows the comparative average cost per ton for handling materials from cars to bins, covering depreciation, labor, fuel, oil, and supplies. From this chart we find that the cost of unloading by hand is 26 cents per ton; with bucket and conveyors, 20 cents per ton; with crawler cranes, 15 cents per ton; with derricks, 14 cents per ton; and with locomotive cranes, 14 cents per ton.

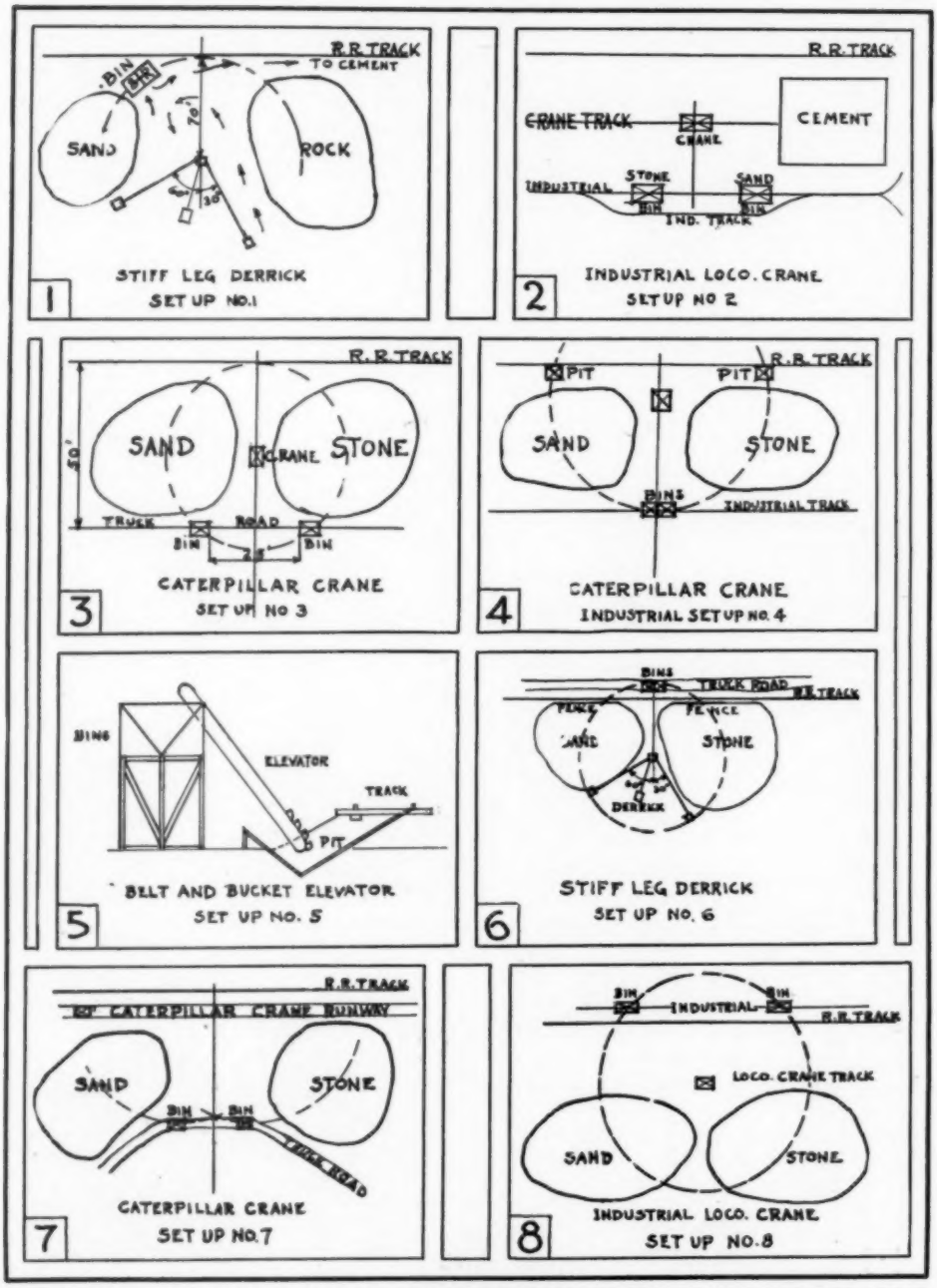
In reviewing these various costs per ton, I do not believe it well to emphasize the results shown too strongly because of the fact that in an investigation of this kind there are not sufficient data available to establish an undisputed cost, but the information can be looked upon as fairly representative, keeping in mind that each individual unit will fluctuate widely because of many variable conditions prevailing at the plant site.

The third group of illustrations have been selected to indicate the relative storage required by various kinds of equipment:

Illustration 1 shows the use of conveyors and bucket loaders; illustration 2 shows the use of a crawler crane; illustration 3 shows a full-



RELATIVE STORAGE REQUIRED BY DIFFERENT KINDS OF EQUIPMENT
1. Conveyors and bucket loaders. 2. Crawler crane. 3. Full-circle derrick. 4. Stiff-leg derrick



LAYOUTS SHOWING BEST RELATION BETWEEN UNLOADING EQUIPMENT, TRACKS, BINS, AND STOCK PILES

circle derrick; illustration 4 shows a stiff-leg derrick. Unfortunately, there is no illustration of a locomotive crane, but reported storage for locomotive cranes shows an equal storage

with that of the crawler crane.

It becomes apparent that storage is obtainable by all types of equipment and is limited only with the cranes and locomotive cranes by the rehandling cost and by the features of the plant site. The derricks are limited to the area under the control of the boom. There is a greater controlled area with the derricks because of longer booms carried by the derricks than are usually carried by the cranes.

The group of eight layouts selected from sketches submitted by contractors show the best working relations between unloading equipment, tracks, bins, and stock piles. These layouts are summarized as follows: 2 set-ups involving derricks; 2 set-ups showing locomotive cranes together with industrial equipment; 1 set-up showing bucket unloader; 3 set-ups for crawler cranes, one of which is an industrial layout.

The features that are emphasized in these set-ups are large storage capacity, reduction of distance between stock pile and bin, reduction of distance between cars and bins, a combination of both of the previous things, and a flexible arrangement for both bins and cranes.

Chart D shows the ratio of contractors reporting their choice of equipment for the handling of materials. This chart indicates that 77 per cent of the contractors prefer cranes, with the majority favoring gasoline power; 14 per cent have chosen locomotive cranes; 6 per cent are partial to derricks; and 3 per cent desire the use of conveyors and bucket loaders. The factors influencing the choice of the majority for cranes are as follows: flexibility in operation and use on other work; ease with which set-up can be made; comparative economy in cost of operations; capacity and control of stock piles.

Conclusions

1. There is an apparent tendency among contractors to standardize on gasoline cranes with clam-shell buckets having load capacities of ¾-yard and 1 yard. This equipment is plainly the choice of a majority.

2. The relative merits of unloading equipment are controlled by: the physical conditions surrounding the plant site; the equipment already owned by the contractor; the human element which enters into the operation of the equipment; the character built into the equipment itself by the manufacturer; and, last of all, but not least, the initiative the contractor possesses and expresses in the use of his equipment.

To the Point

There were two frogs who had accidentally gotten into a farmer's cream can. The first frog immediately gave up a struggle for existence and sank to the bottom. The other started paddling with his feet and said to himself, "I won't give up. I won't give up until I die." When the cream can was finally opened in the creamery, there sat Mister Frog nicely enthroned upon a pat of butter, while his brother lay dead at the bottom of the can. And so the important thing, after all, is what you accomplish with the equipment you have, and not what equipment you have to accomplish with.

ACKNOWLEDGMENT.—From a paper presented before the American Road Builders' Association, Chicago, 1926.

84,000-Pound Steel Casting for Coliseum

A PIECE of steel said to be one of the largest ever cast in the United States, entered Florida through Miami, having been shipped by the Ingalls Iron Works Company of Birmingham, Ala., steel contractors for the $1,000,000 Miami Coliseum. This casting will be used as the principal supporting girder for the proscenium arch and is the largest piece of steel ever to enter Florida. It measures 72 x 10 x 2 feet, weighs 84,000 pounds, and will support approximately 100 tons when placed in position.

The girder has been placed in position at the Coliseum, which occupies the block bounded by Douglas Road and Menores and Zamora Streets, Coral Gables. Four special 8-wheel trucks conveyed it from the Florida East Coast yards to Coral Gables, and two steam derricks hoisted it into place. Eight 60-foot trusses resting on steel and concrete bases extending 14 feet into the ground will support the girder. Twelve carloads of the total of 36 carloads to be used in the steel structure of the Coliseum had arrived by the end of March at the site of the building. Approximately 800 tons of steel will be used in the building, which will measure 200 x 250 feet and will seat 8,000 people. The seating portion of the Coliseum will be 64 feet high, and a balcony which will hold 1,285 people will extend from the front. An 86 x 12-foot orchestra pit will insure ample room for a large orchestra, and an 81-stop organ will be placed on a raised platform, with the console extending into the orchestra pit. Indirect and semi-indirect lighting will involve 12,000 lights, and a lobby 50 x 80 feet, flanked by lounges and rest rooms, will furnish the main entrance. There will be a parking ground for 1,500 cars.

Excavation on the Victory and Lincoln Highways

THIS HEAVY EXCAVATION TOTALED 200,000 CUBIC YARDS OF ROCK

This picture shows one of the cuts from which 35,000 yards of material was excavated by power shovels and removed by Autocar trucks owned by C. R. Adams, Colfax, Calif. This cut is 85 feet high at the highest point, and the fill is 95 feet deep at the deepest point

Difficult Foundation Construction in New York City

Abundant Equipment and Steel Pneumatic Caissons Make Possible the Building of 86 Deep Foundations in 114 Days

By A. G. Hillberg

A NEW 16-story structure reaching from West Street to Washington Street at Carlisle Street, New York, is now under construction by the *New York Evening Post*, under conditions which require a very rapid operation to insure the earliest completion. The greatest difficulty in the construction of the substructure was the requirement to support absolutely without any possibility of settlement the heavy concentrated loads from the tall columns, and also to support independently the great weight and heavy vibrations from the battery of large printing presses. These requirements necessitated heavy concrete piers carried down a considerable depth to satisfactory bearing on reliable hard stratum. These were all operations that were known in advance to be difficult and costly and slow, because the site is on a fill made with ground obtained from cellar excavation and other sources that had built out the water-line hundreds of feet beyond its original location and buried numerous piers, foundations, and forgotten structures, that now present serious obstacles to excavation in the soft, wet soil. It was known that large numbers of hidden foundation piles 20 or 30 feet long and quantities of timber and riprap stone would be met, together with the heavy flow of ground water from the near-by North River. All of these presented serious difficulties for either open or caisson excavation.

In this section of the city the bed-rock is from 50 to 100 feet below the surface and is generally overlaid with a stratum of hard-pan, above which there are often successively gravel, boulders, mud, and fill including large bodies or pockets of very treacherous quick-sand. From the indications of exploration borings, it was believed that the hard-pan would provide bearing adequate for a load of 10 tons per square foot, and it was specified that the piers should be carried down to footings of that character one foot or more below the surface of the hard-pan.

A GENERAL VIEW OF THE NEW YORK EVENING POST BUILDING FOUNDATION JOB SHOWING STEEL CAISSONS BEING SUNK

Knowing this requirement, and provided with a plan showing the location and minimum dimensions of the piers, the contractors elected to build them by the pneumatic caisson process, which permitted simultaneous operations on a considerable number of foundations, provided that an abundant equipment of construction

CEMENT LOCK AND COFFER-DAM WITH PILE OF MUCK AND LOGS WHICH HAVE BEEN REMOVED SEEN AT BASE

plant was installed and a large force of competent men under skilled direction were employed. Accordingly, the entire area of the 176 x 133-foot lot was excavated to a depth of about 9 feet below the curb by a Thew steam shovel, which in two weeks delivered 2,500 yards of spoil to a fleet of 5-ton motor trucks that hauled it about one mile to the dump.

In the pit, timber towers were built to support four stiff-leg derricks with 50- and 60-foot booms commanding all parts of the work, operated by electrically driven Lidgerwood double-drum hoisting engines, which served the entire lot area and handled from the trucks in the street the caissons, coffer-dams and other supplies, as well as material and plant. A 125-yard bin of pre-mixed aggregate was kept filled by the Colonial Sand and Stone Company, a 10,000-bag house was built for the storage of Atlas portland cement, and a 1-yard Ransome concrete mixer was installed in the pit, which was otherwise unobstructed. In this unobstructed area, 86 circular and rectangular caissons, from 5½ feet in diameter to 11 and 16 feet wide and long, were sunk.

A Simplate valve Chicago Pneumatic air-compressor of 600 cubic feet capacity operated by a 100-horse-power Westinghouse motor, three low-pressure air-compressors, air-receivers, intercoolers, a hospital lock, sand-hog house with locker-rooms and washroom, blacksmith shop, pipe shop, reinforcement storage, bending bench with three K-G oxyacetylene cutting torches and other conveniences, were installed in the unoccupied lot adjacent to the building that was rented for this purpose.

Contractors' and engineers' offices were located on storage platforms built over the sidewalk on three sides of the building, and the construction of all the pneumatic caissons and coffer-dams was carried on at the yards of the Federal Shipbuilding Company, Kearney, N. J., instead of adopting the usual reinforced concrete caissons ordinarily used in this locality. The steel caissons for all piers were well calked and, with the exception of one extra large caisson, were delivered complete on motor trucks. As the heaviest caissons weighed only about 10 tons, they were easily unloaded and set in position in the pits dug to receive them, and then were sunk to hard-pan at a maximum speed of a little more than two days each when no obstructions were encountered. This condition was largely theoretical, since the sinking of almost all the caissons was much delayed by the necessity for cutting through

large masses of heavy timber that forms the ancient cribs, bulkheads, and foundations, and by the need for removing large quantities of riprap stone that had ballasted the cribs. In some cases a week or more was required to cut through a single crib with its massive deck of three courses of heavy planks. Several hundred wooden foundation piles 20 or 30 feet long had been driven in all parts of the lot and many of them were loosened by hydraulic jacks and pulled before the caissons were set in place.

Caisson excavation was expedited by the use of pneumatic spades and pneumatic chisels operated in jackhammers, and all of the muck and débris was hoisted through the Matteson air locks, of which seven were provided and shifted from caisson to caisson in special ¼- and ½-yard cylindrical buckets. The excavated material was dumped into hopper-bottom bins in the elevated storage platform and thence was easily delivered by gravity to the fleet of 5-ton motor trucks that hauled it about a mile to the dump.

As the maximum air-pressure did not exceed about 17 pounds, the sand-hogs could work full 8-hour shifts, and the work progressed 24 hours per day, enabling the last caisson to be sealed 114 days after air was put on the first caisson. This is a remarkably good record, considering the obstacles encountered and the very narrow clearances provided between the caissons, which covered so large a portion of the entire area of the lot that there was scarcely room between them for the track on which the concrete was distributed by flat cars carrying 1-yard buckets from the mixer to the different caissons.

As the caissons descended, their walls were built up with sectional coffer-dams, that for the circular caissons were made with riveted steel sections, and for the rectangular caissons with full-size side panels of vertical planks, bolted to, and connected by, transverse horizontal angles, which greatly facilitated their rapid assembly.

Collapsible wooden cores were set inside the coffer-dams to provide for the air-shafts, and after they were removed and the working chambers concreted under pressure, the air-locks were removed and the air-shafts concreted in the open. The air-shafts, which served both for men and for materials, were equipped with individual single-drum Lidgerwood hoists supplemented by some other makes. Concrete not handled by the derrick system was mixed wherever it was required to be used, by a Boss mixer mounted on a four-wheel steel truck and driven by a LeRoi gasoline motor.

Underpinning

On three sides of the lot it was only necessary to put in light sheeting to retain the earth, but on the fourth side, where there was a 3-story brick building within a few inches of half a dozen caissons, it was thought wise to underpin the shallow footings of the wall and carry its support down to hard stratum before commencing excavations that might possibly involve some displacement of the loose sand and cause the old structure to settle. Accordingly, six pits were excavated below the general subgrade adjacent to the base of the wall, and in the bottom of them smaller pits, 4 feet square and extending under the whole width of the old footing, were carried down 7 feet deeper to provide for the underpinning operations. In each of these pits a 6-foot length of 15-inch steel pipe was driven down vertically by three 100-ton Watson-Stillman hydraulic jacks set between it and the old footing. A similar section of pipe was placed on it and connected to it by an inside sleeve coupling, jacked down, another section added, and so on until a resistance of 80 pounds per square inch was shown

USING A 100-CUBIC-INCH ORANGE-PEEL BUCKET TO REMOVE MUCK FROM PIPES

on the pump-gage. The soil and débris were excavated from the interior of the pipe by a hand-operated Hayward dwarf orange-peel bucket 11½ inches in diameter, which weighed only 30 pounds and does proportionately as heavy and efficient work and does it faster than the ordinary heavy-duty bucket of the same make for standard rock and earth work. The little dwarf, with a capacity of only 100 cubic inches, has been developed from the big model expressly for inaccessible excavations in limited clearances. It easily brings up the biggest pieces of timber and rock that can be passed through the pipe, in spite of its miniature proportions.

After the driving and excavation were completed, the pipes were filled with rich concrete made with small aggregate, and the upper part of the pipes was imbedded in a mass of concrete extending 2 or 3 feet above the tops and within a few inches of the bottom of the old footing. Connection was then made between this concrete and the footing by the usual method of wedging plates that were adjusted to solid bearing without carrying the full weight of the building that might later come on it if any settlement threatened the old footing. The completion of the work and final adjustment was made to secure uniformity in wedging, and the wedges were permanently sealed in concrete and grout.

The work was executed rapidly and successfully by an average force of about 100 men on the day shift and 50 men on each of the two night shifts, under the direction of Alexander Lyle, resident engineer, and Robert Gunkel, superintendent. Horace Trumbauer is the architect, and Charles Scott Landers the consulting engineer. The Thompson-Starrett Company is the general contractor, and the Underpinning and Foundation Company the subcontractors for the substructure, including the foundation piers, the cellar walls, and the very thick reinforced concrete cellar floor, which requires about 8,000 cubic yards of concrete.

Welding Temporary Pipe Lines

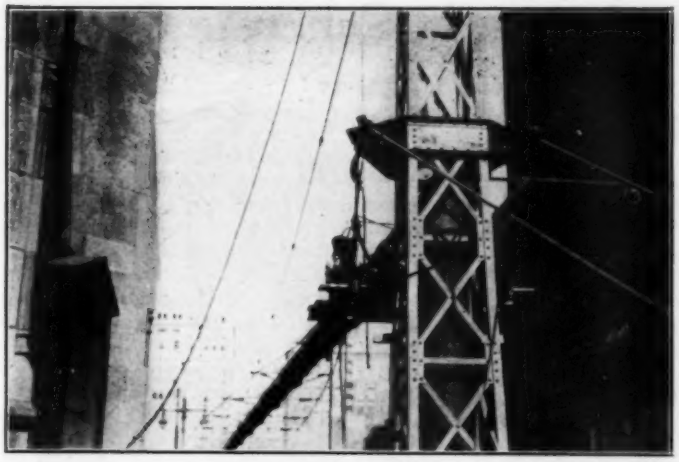
This Method of Joining Has Been Found as Economical as for Permanent Lines

THE gospel of gas-welded pipe lines has been preached for years. No one can say this missionary work has been without results. One point that has been dwelt upon in particular is permanence. Proponents of welding have expounded at great length the permanence of a welded pipe line and the permanent tightness of a welded pipe joint. This idea has gradually become instilled in the minds of all. Perhaps it has sunken in even deeper than had been anticipated, because some people seem to have gained the impression that welding is satisfactory only for permanently laid mains and trunk lines but is not practical for temporary lines. Nothing could be farther from the truth.

A large percentage of the permanent lines constructed during the last three or four years, the larger and longer ones especially, have been welded. However, almost all temporary lines have been put in with screwed joints and with patent couplings. By temporary lines is meant those that are laid with the intention of ultimately taking them up and relaying them elsewhere, perhaps within a month, a year, or five years. Such lines are continually being laid and relaid; for example, water and compressed-air supply lines for highways, hydroelectric dams, subways, and other engineering construction operations, and feeder lines for individual gas or oil wells to main trunk pipe lines. These lines are as a rule of relatively small diameter, 2-, 3-, or 4-inch, and the pipe is usually bought in 20-foot lengths.

By using 20-foot lengths of pipe there naturally will be a large number of joints with a proportionately large chance for the development of leaks and increase of up-keep expense. In the welded line, either permanent or temporary, this is reduced to a minimum or entirely eliminated. The labor of putting down or taking up a line with many joints is one of the largest items of expense, since the time and attention required per joint must be expended a greater number of times.

A pipe line company in Texas recently took advantage of this opportunity. They had arrived at a point where it was necessary to move a 3-inch line. It had originally been welded. Instead of cutting the line at each welded joint, it was cut every 50 feet, the cuts falling wherever they might come. As 50-foot flat cars were available to transport the pipe to the new field, this cutting of the pipe made capacity loads possible. It also greatly reduced the number of welded joints necessary when the line was relaid. Had screw couplings been used originally, the number of joints to be



WELDING TEMPORARY OVERHEAD GAS MAINS IN NEW YORK CITY

unscrewed, inspected, re-threaded and again coupled together would have been greater by 100 per cent. This, with the corresponding reduction in labor and handling, represents the saving that should not be overlooked by the progressive contractor.

Another factor to be considered is the damage sustained by the pipe when taken up. Joints will have become rusted or corroded so that the threads hang on like grim death. As a result, threads are twisted off or damaged and new ones must be cut. This isn't so easy on the dirty pipe. Pipe ends or couplings are frequently split. Likewise, after the joints are coupled, threads will become battered or otherwise injured. The only sure way to prevent this is to use protective caps, which are expensive, to say the least.

The oxy-acetylene process is the answer to the large problems of relaying screwed pipe. When the pipe has been cut with the blowpipe, it can be handled without thought of damage, lengths can be welded together again without any special attention unless the ends have been smashed completely out of shape. Even then, it is a matter of but a moment to heat the end with the welding blowpipe and bring it back to shape with a few blows of a hammer. If too badly battered, the damaged part can be cut off in a jiffy with a cutting blowpipe.

There are some who will say offhand that welding is too expensive for a temporary line. This idea is easily exploded. If welding is not too expensive for permanent lines, it is not too expensive for temporary lines. It has repeatedly been demonstrated that, mile for mile, it is cheaper to weld pipe than to employ any other means of joining. This statement is based on the assumption that new pipe will be used, but welding can be done on used or second-hand pipe. In fact, there are many companies which make a business of welding used pipe, scrapped boiler tubes, and drawn well casings into long lengths. Any pits or corroded spots are filled up by welding. Pipe that has been so reclaimed is then sold to oil and pipe line companies and to contractors.

In the light of all these facts, it is easily seen that welding greatly increases the potential value of pipe regardless of whether it is to be laid permanently or temporarily, and hence objections to the use of welding for temporary lines are entirely unfounded.

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New Inter-Mountain Representatives

THE Gilman Manufacturing Company, East Boston, Mass., makers of rock drills and mining machinery, have announced the appointment of the Colorado Iron Works Company of Denver, Colo., and Salt Lake City, Utah, as exclusive agents in the inter-mountain district. This company will cover the states of Colorado, Utah, Wyoming, and Nebraska, and parts of neighboring states which are logically included in the territory.

New Climax Distributors

THE Climax Engineering Company, Clinton, Iowa, has appointed the H. Y. Smith Company, 1301 First National Bank Building, Milwaukee, Wis., as distributors for Climax engines in Milwaukee and eastern Wisconsin. The A. K. Miller Engineering Company, 112 North Water Street, Mobile, Ala., have been appointed agents for southern Alabama, while L. H. Staley, 515 Whitney Building, New Orleans, is the new Climax dealer in Louisiana.

New Experiences in Concrete Control

By John G. Ahlers

Barney-Ahlers Construction Corporation, New York City

THE procedure for concrete strength control outlined in this paper was developed during the process of instructing the Barney-Ahlers field organization in control of concrete by the water-cement ratio.

What Is the Water Ratio Theory?

The water ratio theory, according to a pamphlet, "Design and Control of Concrete Mixtures," published by the Portland Cement Association, is that, for given materials and conditions of manipulation, the strength of concrete is determined by the ratio of the volume of mixing water to the volume of cement (water ratio) so long as workable mixtures are obtained. In other words, if one cubic foot of water is used for each cubic foot of cement in a concrete mixture, the strength at a given age is fixed, regardless of what quantities of other materials are used, so long as the mixture is plastic and workable and the aggregates are clean and made up of sound, durable particles. The significance of this important conclusion is more readily appreciated when the cement paste is thought of as a glue, binding the aggregates together. The addition of excess mixing water serves only to dilute the glue and reduce the strength. Less than 2½ gallons of water is sufficient to hydrate one sack of cement. While it is necessary to use more than this amount to produce a workable mix of concrete, any water in excess of that required to hydrate the cement reduces the strength and makes a more porous concrete.

The quantity of cement, the plastic condition or workability of the concrete (whether it is wet or dry), and the size and grading of the aggregate, affect the strength of concrete only in so far as they affect the quantity of water required in the mix. The important influence of these factors has long been recognized, but the part played by each was not clearly understood until their relation to the quantity of mixing water was demonstrated. More than 100,000 tests made at the Structural Materials Research Laboratory and numerous tests made at other laboratories have demonstrated the accuracy of the water ratio theory. For concrete made under average conditions and cured in the presence of moisture, the compressive strength may be expressed by the equation:

$$S = \frac{14{,}000}{7^x}, \text{ in which} \qquad \text{(Equation 1)}$$

S = compressive strength of concrete at 28 days, lb. per sq. in.

x = water ratio $\left(\frac{W}{C}\right)$ (an exponent).

From the above equation, it will be seen that the compressive strength (S) increases as the water ratio $\left(x = \frac{W}{C}\right)$ decreases. It should be pointed out that these constants were determined for definite conditions of test. It would not be expected that exactly the same constants would be found for other materials and other conditions of test.

In Figure 1, curve A represents this equation, and curve B, the equation

$$S = \frac{14{,}000}{9^x} \qquad \text{(Equation 2)}$$

This latter equation differs from the first only in that the constant in the denominator is 9 instead of 7. It gives strengths approximately 500 pounds per square inch lower than the first, and may be considered as a reliable indication of the minimum strength to be expected where the concreting operations are not under rigid control. As an example in the

Distinct Advance in Field Control of Concrete

This article is prepared from the conclusions appearing at the end of a 36-page paper of the same title, presented by Mr. Ahlers before the American Concrete Institute at its Twenty-Second Annual Convention, and is printed by permission from the paper which will appear in the forthcoming copyrighted "Proceedings of the American Concrete Institute." The paper discusses an attempt to clarify the problem of concrete control by making field work much simpler and hence supervision easier. It was accomplished by a contractor's organization in cooperation with engineering firms on six building operations. By using the water ratio theory only, strength is regulated by constant balance of water to cement by weight in a simple device, with allowances made for moisture in the aggregate.

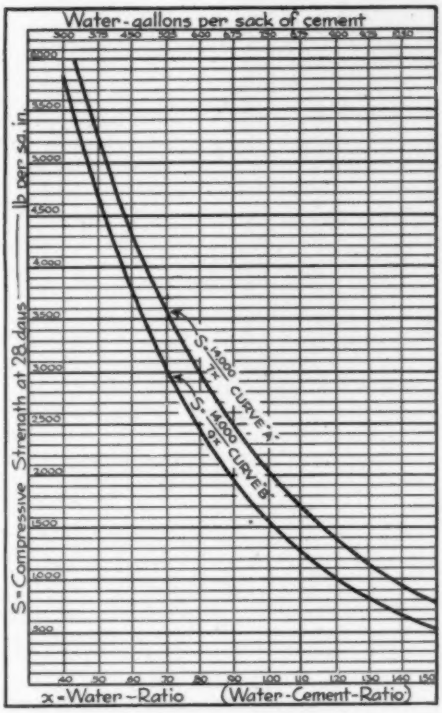


FIGURE 1.—CURVES OF COMPRESSIVE STRENGTH WITH DIFFERENT WATER-CEMENT RATIOS

use of this diagram, it will be seen that if concrete is mixed with a water ratio of 1.00 (7½ gallons of water per sack of cement), the strength at 28 days which would be expected under average conditions is 2,000 pounds per square inch (curve A) and the minimum strength is 1,500 pounds per square inch (curve B).

Conclusions Reached on the Job

The water-cement ratio theory has been given a fair trial under job conditions by a contractor's organization and under the eyes of many engineers. Attempt was made to work for progress and knowledge without prejudice for or against any certain materials, tools, or method of manipulation. As a result, the writer firmly believes that we are approaching much better and simpler means of field control of concrete and wishes to emphasize the following points:

1. The water ratio theory of concrete control is practical and can be applied to field conditions for producing concrete of uniform strength and of predetermined strength within reasonable limits.

2. The method of field procedure outlined below affords such a simple and economical method of controlling the quality of concrete, that, where understood, engineers, architects and contractors have welcomed it.

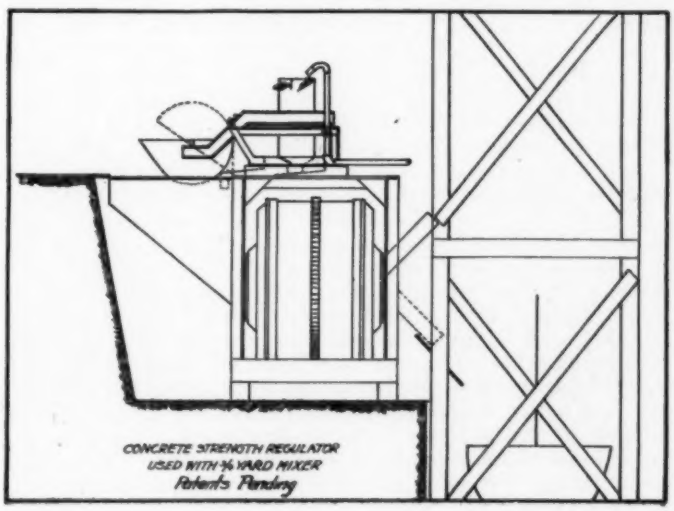
3. On six building operations, new methods described below produced decidedly more uniform results than shown by tests from former field conditions reported by Ahlers and Walker, American Concrete Institute *Proceedings*, 1924.

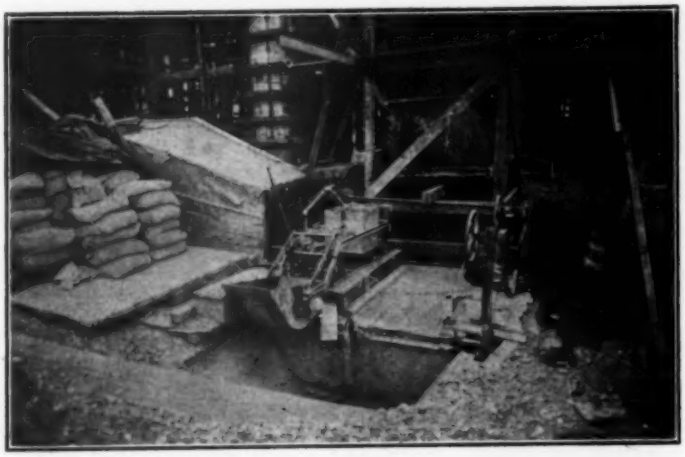
Equipment Developed

The device or tool used to control the water-cement ratio has been developed and improved during the last year and has reached the stage of a practical piece of contractors'

DIAGRAMMATIC SKETCH OF CONCRETE STRENGTH REGULATOR, SHOWING POSITION IN RELATION TO MIXER

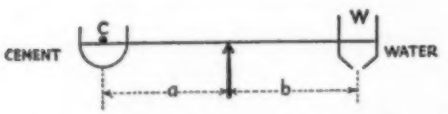
See photograph on next page





CONCRETE STRENGTH REGULATOR AS SET UP ON A BARNEY-AHLERS JOB

plant. This machine is called a Concrete Strength Regulator, and that is its function and purpose. The statement in the Bulletin of the Portland Cement Association, "The water ratio theory . . . that, for given materials and conditions of manipulation, the strength of concrete is determined by the ratio of the volume of mixing water to the volume of cement (water ratio) so long as workable mixtures are obtained . . .," explains in itself the necessity for such an appliance. Taking into consideration the fact that variations in the amount of cement for a given ratio must be compensated for automatically, the machine is in principle a balance, the weight or volume of water being balanced against that of cement.



Moments about the fulcrum will determine the distance "a" for a given ratio, C being constant. $\frac{a}{C}$ expresses the water-cement ratio in terms of weight. The machine consists of two parts—the rigid frame and the balance-frame. A knife-edged fulcrum connects the two. The balance-frame, bent as illustrated in order to lower the level of the hopper to obviate high lift of the cement bags, holds at one end the cement hopper and at the other the water-tank. The hopper is pivoted, so as to allow the cement to be dumped by tipping and to insure that the center of gravity always passes through the same point. The water-tank slides in the other end. Two screws operate the movement of it so as to allow for change of ratio.

The flow of water to the tank is automatically cut off by the falling of a trip lever after it has first been raised to open the valve, the moment the point of balance is reached. The indicator scale on the side of the balance-frame will tell the position of the tank for a definite delivery of water. From the gallon-scale inside the tank its position can be checked by actual calibration.

To use the machine, the operator should set the tank at the position which will automatically give the previously calculated amount of water for the desired strength of the concrete. The machine does not have to be altered again until such time as a change in strength of concrete is desired.

The man at the cement now does the following: First, he empties into the hopper the required number of bags; this done, second, he raises the trip lever until it catches on the pin holding the valve in the open position; and, third, he waits until the water has shut off of its own accord.

The cement and water are now dumped and discharged as soon as the whole charge is ready for the mixer. The rest is now repetition, and the cement man will always be ready in advance of those handling the aggregate.

The relative position of the regulator and the mixer is shown very clearly by the sectional drawing and photograph of a machine on actual building operations. The engineers on all building operations where a regulator was used have approved its use as assuring them that the concrete placed in the structures is kept under rigid control.

Beating the Labor Shortage

By James S. Frear

LABOR short? Need it be? Have you ever figured on a way to overcome it? Maybe that's where we've all fallen down more or less. Yet, the fact remains that we are short on building labor almost every year. And the main shortage that hits us all is in the efficient craftsman, who seems to have gone to that same far distant land as has the dodo.

It's so long since there was a general apprentice system that it takes one of the "oldest inhabitants" to recall it to us. I remember, years ago, when I was serving an apprenticeship at pounding my thumb instead of anything else, that I used to laugh at the foreigners who were working on the job. There were a lot of Scandinavian carpenters in that locality and they told about the long apprenticeship they had to serve—seven years to our four. And I thought I was a lucky fellow.

Then I gathered an armful of books and acquired a little technical training at some one else's expense. I *knew* that I was way ahead of these same fellows then. Not long afterwards I worked on the same job with some of them, and found they had a more practical method for about every technical stunt that took me half an hour to work. Right there I began to respect that apprentice system more and more.

But it became exceedingly unpopular to use apprentices. The young fellows who used to learn a trade were beginning to go to high school and college—and they wouldn't look at a poor workingman. The only difference between them was on pay night, and then the "poor workman" had a decided advantage. But, with it all, the apprentice system took away the tide of trained mechanics that came from it before its decline.

Schools began to teach manual arts. Even grammar-school boys gathered a fair knowledge of joinery and building. That was a fine thing, and should have helped them into the craft had they been properly guided. But the aim of that system seemed to be the building of book-troughs and settees. Then the trade school came into its own—but that was so recently that there are only isolated instances where it is proving out, and they have not been established long enough to gather a teaching force that is coordinating the school work with that of the field.

The day of the specialist came with the decline of the apprentice system. It got so that we had to get a man for every different sort of job, instead of having the journeyman who could handle a concrete form or do a bit of difficult trim work. To the man with a great deal of work this was an advantage, for he could place his men on the particular departments they were best fitted for, and work the men in gangs.

But even the specialist, in the finer branches of the business, has become harder and harder to locate. And the present condition finds us pretty well down into the trough of the sea of business, hoping that we may soon ride up to the crest of the wave with the labor market in a better condition.

While this has been going on in the building industry, other industries have met their labor shortage. The Ford plant is a fine example of how the manufacturer has met it. With the highly specialized manufacturing methods in vogue there, little need is seen for doing more than training a man to perform one routine task—and then to develop him into a machine-like workman, capable of being speeded up from day to day.

Special machinery has been developed to care for many of the tasks: first, the automatic lathe that manufactured screws; then the development that brought them to handling parts which had been partially completed on other machines; then on into still more highly specialized machinery, until it seemed scarcely necessary to have any workmen about at all.

That does very well for the industries where it is possible to perform an endless duplication of tasks in the same place at all times. The construction industry cannot do that. Even the machinery development has been slower in this industry; and that because of the individualities of design which have worked against such developments.

Despite that, there have been gradual developments that have worked to the advantage of the industry, and the slowly gathering speed seems capable of bringing even greater changes in the coming decade. Looking back over the past decade, it is easy to note the greater developments of the latter half than of the first—more mechanical devices, each designed to lighten, expedite, or remove the necessity for hand labor. It is no easy thing to do, but it is being done a little at a time, and I can anticipate the day when much of the harder portion of the building labors will be mechanically performed.

The changing processes of building have aided this a great deal. From the all-wooden days we have passed into a partial masonry state that will develop much more. The farther we travel along that path the more will machinery take its place in the industry, releasing laborers and craftsmen for the more difficult and intricate tasks.

Just as the workman laboriously walking up ladder after ladder with his load of bricks or mortar, gave way to the hand elevator, and that to the power one, so will the hand tasks of to-day give way to the mechanical ones of to-morrow. Not only will the structural methods develop with the change, but one will bring the other into being; just as has already been done in several instances.

Instead of building a complete wooden floor, with the beams and girders represented by water-tight troughs, there are the floor cores of to-day. The form work is reduced to the line of planking which supports the core and forms the bottom of the beam; the supports being designed to carry the load. Instead of cutting and splicing these supports, they are provided with adjustable units, each being used many times without there being any salvage labor.

In place of carefully attaching building paper over the sheathing of a frame house before the metal lath is applied for the stucco, we have a metal lath with the tar paper made integral with it. Or, if that is not desired, there are a number of different materials which combine the functions of sheathing, paper, and lath, to which the stucco may be applied.

From the hand mixing days to the concrete mixer was not so long a jump. It was a longer one from the long runways for wheelbarrows to the chuting plant. And then for the chuting plant to be so applied that the smaller contractor could make use of it, was another sizable lapse of time. Then came the stucco machines that reduced the time and labor necessary for the application of the exterior coat—and increased its strength.

Each of these steps marked an advance in methods and machinery, and each was the outcome of a new method or material. The use of the materials or methods or machines trailed behind the development of them; but that is an ordinary thing and scarce needs mention only as it calls attention to the fact that we do not study the fundamental possibilities of these innovations in the manner which we should—the old antipathy against changing from something we know to be satisfactory after a fashion.

From the wooden box culvert, or the cut stone one which lived during the same period, we stepped into the use of concrete for this work. Then came the corrugated steel culverts that took up so much space that some one devised the nested culvert. Step by step each part of the industry advanced. Macadam roads gave up part of their prestige to the concrete ones. The hand finishing of the concrete road gave way to the finishing machine. The portable mixer for roads developed into the central mixing plant and the use of either trucks or industrial railways. The changes are so many that they could be recorded on page after page. It is their lesson that has the greater use to us.

Every time that a new machine has come into the market and has proved itself of value, we have seen a reduction in the costs of that particular branch of work, and the release of a few laborers for other tasks. We must recognize that we are in a mechanical age. We must arrange our specialized tasks in such a manner that there will be a sufficient labor supply to care for them. We must develop machinery to care for the other and more routine tasks. We must arrange an equipment program that will foresee the coming shortages of labor, and will obviate them through inventive ability and the use of the devices which efficiently perform these tasks. Then we shall surely have beaten the labor shortage.

New England's Second Open-Air Road Show

THE second open-air Road-Building Machinery and Equipment show of the Massachusetts Highway Association is to be held May 13 and 14 on the Charles River Parkway at the Cottage Farm Bridge, Cambridge, Mass. Last year there were 35 exhibitors and it is expected that there will be approximately 90 exhibitors this year.

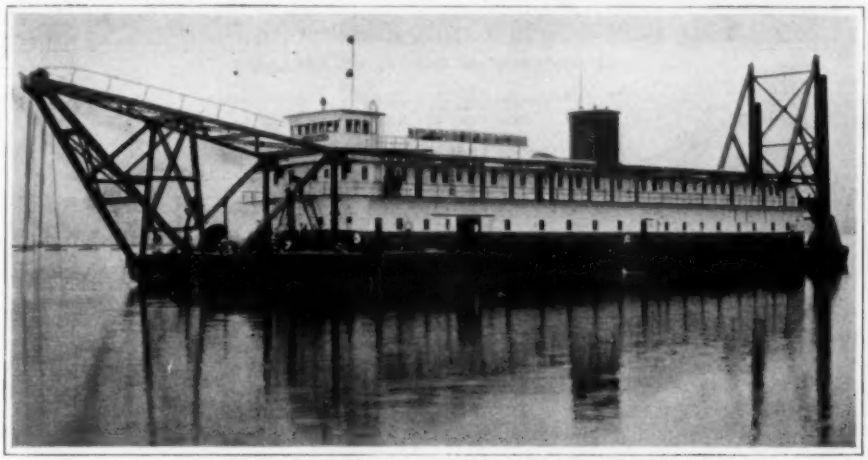
The Executive Committee in charge of the Show consists of Fred B. Richardson, President, Massachusetts Highway Association; John M. McCarthy, Secretary, Massachusetts Highway Association; James O. Jordan, Jr., Hedge & Mattheis Company, Boston, Mass.; C. F. Reuter, Tractor Division, Mead-Morrison Manufacturing Company; and B F. Surrett, Dyar Sales and Machinery Company, Cambridge, Mass., all well-known in the construction field.

The Diesel-Electric Dredge "Clackamas"

By Robert C. Smith

THE city of Portland, Ore., is situated on the Willamette River, 110 miles from the mouth of the Columbia River. In order to maintain an adequate marine road from Portland to the sea, the project has been divided so that the Port of Portland concentrates on the Willamette River and the Portland Harbor area, while the United States engineers maintain their floating plant in the Columbia River from the mouth of the Willamette River to the Pacific Ocean.

When the Port of Portland decided to undertake the Swan Island improvement, which includes deepening the harbor, straightening the channel of the river, and reclaiming many acres of waste land, it was decided to increase the dredging equipment by the addition of a high-powered dredge. This resulted in the design and construction of the diesel-electric dredge "Clackamas," which is not only the most powerful pipe line dredge of its type in the world, but is also said to be the most economical.



PORT OF PORTLAND DREDGE, "CLACKAMAS"

The steel hull of the Clackamas was built by the Wallace Equipment Company of Seattle, Wash., on the ways of the Peninsula Shipbuilding Company, Portland, Ore. After the launching on February 26, 1925, the hull was towed to the Port of Portland dry-dock, and the machinery was installed by the dredge's own crew. The dredge had its trial run on August 1, 1925, and since then has been in constant operation and is giving most satisfactory results.

The dredge was designed by the Port of Portland engineering force under the direction of James H. Polhemus, General Manager and Chief Engineer of the Port. The hull is of steel and is 236 feet long, 50 feet beam, 12 feet 9 inches deep, and has a displacement of 2,480 tons at draft of 7 feet 8 inches.

The Port, having had three dredges sunk, two from being rammed by steamers and one by the bursting of the discharge pipe, gave particular attention to the construction of the hull in order to make it strong enough to hold the heavy diesel engine equipment and minimize the damages as much as possible in case of collision. On each side of the hull, located 7 feet inboard from the shell plating, is a longitudinal water-tight bulkhead about 188 feet long, extending from the forward athwartship bulkhead to the after athwartship bulkhead. This also strengthens the hull, particularly the bottom, to offset stresses in case of grounding. The space between this bulkhead and the side of the hull is divided by athwartship bulkheads, making six water-tight compartments on each side of the hull.

These water-tight compartments are used for storage of fuel oil, diesel oil, lubricating oil, and potable water, thereby saving space which otherwise would be taken up by separate tanks, as well as conserving weight and cost.

Four transverse water-tight bulkheads divide the hull into six compartments between the longitudinal bulkheads. These bulkheads

ENGINE-ROOM OF DREDGE "CLACKAMAS"

also strengthen the dredge, through being placed between the different main machinery units and thoroughly tying the machinery keelsons to the longitudinal bulkheads and to the sides of the hull.

The aft engines and their generators are in one compartment. The forward engines and their generators and the main pump motor are in another compartment, and the main dredging pump is in a separate compartment. Should the bottom of the dredge be damaged, causing the filling of any one of the compartments, the damage would be local and affect the electrical equipment in that compartment only. Similarly, should a hull pipe or the dredging pump be ruptured from any cause, the damage would be limited to the compartment where the break occurred.

There is a heavy bridge type steel truss extending the full length of the hull, the forward being extended to form the A-frame for the ladder hoist, and the spud mast aft being tied into and forming a part of the truss. This truss also carries the crane runway girders and is calculated to support the weight of the dredge in case of grounding in the two ends.

The spuds are 35 inches in diameter and 80 feet long, constructed of ¾-inch steel plates rolled into a cylindrical tube. There is a hollow cast steel conical point at the bottom for setting into the bed of the river. There are fourteen flanged diaphragm plates riveted to the shell, spaced about five feet apart throughout the length of the spuds, which keep the spuds from buckling under a beam strain. Constructed in this manner, these steel spuds have double the strength of timber ones and are easily repaired or rebuilt in case of damage.

The spud wells are placed at the stern and constructed of heavy cast steel hinged keepers, which enable the removal of the spuds should they become bent. The dredge crew with the equipment aboard can readily replace a damaged spud.

Diesel Engine Equipment

The main installation consists of two 800-horse-power McIntosh & Seymour diesel engines, stationary type, each direct-connected to a 540-kw. d.c. generator and two 900-horse-power marine-type diesel engines of the same make, each connected to a 600-kw. d.c. generator.

The combined power is 3,400-horse-power, and the total consumption of fuel oil is 4¼ barrels per hour at full power, or 102 barrels per day of 24 hours. However, the average pumping time will probably not exceed 20 hours per day, and with varying loads will require the consumption of about 75 barrels per day.

Dredging Pump

The main dredging pump is a high-speed square volute lined centrifugal-type pump developed by the Port of Portland, having 30-inch suction and discharge openings. This pump is direct-connected to a 2,700-horse-power variable-speed constant-power motor

having a speed reduction or regulation from 250 to 360 r.p.m. Through the speed reduction provision, discharge pipe lines varying from 1,000 to 7,000 feet in length may be served with the one size of impeller.

Living Quarters and Equipment

Careful attention has been given to the living quarters of the crew of 50 men. The galley is equipped with electric ranges and bake ovens, while a 2-ton refrigerating machine is a welcome adjunct. There is a well-equipped laundry. A wash-room with shower-baths is a great help toward maintaining an energetic and industrious crew. The social halls are equipped with radios.

A complete machine shop with power tools, traveling cranes, and other such equipment is located on the main deck. All the pipe valves and fittings for the power installation as well as for the sanitary equipment were furnished through the Portland branch of the Crane Company, which also supplied all the plumbing fixtures and heating materials.

ACKNOWLEDGMENT.—Text and illustrations by courtesy of the *Valve World*, published by the Crane Company, 836 South Michigan Avenue, Chicago, Ill.

The Proper Control of Materials in Concrete

By Robert E. O'Connor

J. C. O'Connor & Sons, Highway Contractors, Fort Wayne, Ind.

WE are all interested in the underrun of cement as well as the overrun; and, furthermore, the quantity of cement used on a job is so closely dependent on the aggregate and the construction practices that we must direct our attention to the latter rather than to the discussion of cement as a material.

Cement has been overstressed in connection with overrun and underrun. The use of the word has been so general that it has clouded the issue. Most contractors and engineers have either lost sight of the fact, or have not realized, that simply because they are controlling the variation in cement safely between certain limits as set out in a specification, this does not mean the stopping of losses in other materials used; and that usually through a lack of knowledge, or a too earnest effort toward the controlling of the cement content by the inspector or the contractor's organization during construction, the result is a loss through excessive or insufficient use of aggregate, both in quality and quantity of concrete produced.

Overrun in Theory and Practice

In figuring overrun and underrun of materials, the theoretical quantity of each kind necessarily must govern. It is the exception to the rule when any allowance is made in specifications to take care of losses, except in some cases a variation in cement. Contractors are prone to leave out of their estimate of quantities any provision for additional materials, over and above the theoretical amount, in spite of a positive knowledge that an extra allowance is necessary to prevent a loss in construction.

While this is true from the view-point of the contractor who has benefited by his experience in construction, there are two bases on which to figure overrun or underrun in a job—the theoretical quantity, from the engineer's side, and that of actual practice, from the contractor's side.

What may be overrun to the engineer might be a figured loss by the contractor. A peculiar situation arises, particularly on jobs where cement is furnished by the contractor, and where the attention is directed more to prevent underrun without considering overrun of cement.

Much could be said about who is responsible for the conditions that exist and under which we work; but a great part of it is clearly the fault of the contractor. We can help our case by obtaining the information necessary to prove it. We should do so at once and strive to correct it; for what will tend to straighten out our trouble will at the same time result in a saving of materials, cement included, at no loss in quality of product, and will establish a real and actual basis of figuring overrun and underrun.

Causes of Overrun and Underrun

For discussion, we will divide the factors entering into overrun and underrun of materials, cement included, under two main headings: first, the specifications; second, the methods and equipment used in construction.

These two divisions are practically of equal importance, and inseparable. Faults in either one will destroy to a greater or less degree the results desired, in proportion to the seriousness of the fault.

Since specifications are written before construction begins, they are given first place. Contractors, at best, are more or less agents of the engineer in carrying out his ideas as set forth. Prevention of overrun or underrun of materials, instead of being aided by the average specifications, is almost bound to occur because of their requirements. A contractor is trying to do an impossible thing when he contracts to meet a rigid specification for neat depth and quality, and, at the same time, confine himself to a definite material content, cement included. This cannot be accomplished in a practical way if the specifications which regulate the mix and methods of construction are to be complied with.

It is evidence of an uncertainty or lack of definiteness when we find that highway specifications which allow practically no variation in finished thickness of slab, do permit a variation from the stated cement factor ranging from 2 to 7½ per cent, and no allowance for increased yardage of sand and coarse aggregate. This indicates clearly that there is need for a definite and equitable basis for estimating the correct quantities of materials.

Specifications Should Safeguard the Contractor

Engineers, in their specifications, should recognize the necessity and importance of safeguarding the contractor against overrun of materials as zealously as they guard against underruns, not by consent to laxity of skill or method by the contractor, but by removal of the uncertainties from their requirements. For example, when a specification requires a 1:2:-3½ mix, just what is wanted? Does it mean 2 cubic feet of wet sand or 2 cubic feet of dry sand? Does 3½ cubic feet mean 3½ cubic feet of coarse aggregate with 30 per cent voids, or 3½ cubic feet with 50 per cent voids? When it is stated that each cubic yard of concrete in place shall contain 1.7 barrels of cement, what limit is there placed on the adding or deducting of fine or coarse aggregate to maintain it?

Consider the design of the section of slab using the thickened edge. Why is change in thickness made so abruptly, making it impossible to cut and maintain in actual practice? A gradual change in depth in the nature of a curve would make a workable design and give the same results, the only difference being that the extra concrete necessary would be taken into consideration when the end area is figured and provided for, and not lost in construction by the contractor and considered as overrun.

When a deduction is made from the contract price for variation in depth of slab below that specified, why isn't additional payment made for increased depth within certain limits, or quantities added to care for it? Why not include an item in proposals to cover overrun and underrun of pavement depth; payment to be made in accordance with clauses safeguarding the state against carelessness of the contractor in construction, but safeguarding the contractor where variations occur in spite of his honest efforts to prevent them?

Where such uncertainties and conditions exist, and a contractor is not permitted to save himself by applying certain safeguards, entailing no loss in quality of concrete produced, he is due for a loss in materials over and above the amount theoretically necessary for the concrete to be placed, even though the cement factor is not exceeded.

Both the engineer and the contractor should recognize each other's position and desires and, through cooperative endeavor, strive to wipe out doubt and uncertainties causing the trouble. This, with an understanding as to the results sought and an honest effort in carrying out the construction, will do wonders in stopping overrun and underrun of materials.

Efforts to Prevent Overrun and Loss of Materials

Assuming that the specifications have been established from the time that shipment of cement and aggregate is started to the job, the contractor, with the assistance of a competent inspector, should begin at once to exert every precaution to prevent overrun or loss of materials.

The following items should be carefully observed and controlled to obtain the maximum saving in materials:

Checking shipments of material as to tonnage and quality.

Storage of material and safeguarding against weather.

Specification requirements for large amount of materials in storage ahead of construction.

Number of times aggregates are rehandled entailing loss with each handling.

Measurement of aggregate: Bulking action of sand; variation of voids in coarse aggregate.

Number of handlings of cement with loss for each handling.

Method of delivery of batched material to mixer, and effect on condition of prepared subgrade.

Subgrade: soil conditions; weather; whether a graded section or not.

Fine grading: soil conditions; care with which rough grade has been done; method of setting forms and resurfacing; subgrader; specification for rolling, and watering; cross-section of completed subgrade; method and specification for testing subgrade.

Mixing and finishing pavement slab; stability of side forms; correctness of finishing template; consistency of concrete; method of finishing; wastage over forms.

Survey Gives Opinions on Causes of Overrun

A survey was made of many state highway departments from coast to coast, and in reply to a questionnaire the consensus of opinion attributes the cause of overrun to two main items; first, the measurement of aggregate; second, the correctness of the subgrade.

The replies also indicated the effort that is being made to meet the conditions and eliminate the objectionable features connected with the problem of overrun of materials, including cement, in highway construction.

The Bulking Action of Sand

It is well established that fine aggregate or sand is subject to bulking because of the natural moisture contained. It is safe and conservative to assume that when a cubic foot of commercial stock-pile sand is measured out loose in a box, the volume of sand will shrink about 25 per cent if the sand is either completely dried out or saturated with water. This is exactly what takes place on the paving job where bulking is not corrected. The bulk sand is introduced into the mixer drum, together with the cement, gravel or stone, and water. Immediately when the sand and mixing water make contact, a decided shrinkage takes place.

Let us examine the effect on quantity of materials used. Assume a six-bag batch of a 1:2:3 mix which would nominally contain 6 sacks of cement, 12 cubic feet of sand, and 18 cubic feet of coarse aggregate. The sand, when measured by volume without correction for bulking, will shrink to approximately 9 cubic feet, and instead of placing 36 cubic feet of sand, coarse aggregate, and cement in the mixer for each batch, there are only actually 33 cubic feet present. It will be found that the yield of concrete suffers a loss on this account of over 8 per cent, and it is almost directly proportional to the true volume of materials going into the batch.

Taking a mile of 18-foot concrete road of 7-inch uniform thickness, we find that a six-sack batch, of 1:2:3 mix, is designed to build 2.266 lineal feet of such pavement. Actually, when bulking of sand is not corrected, it will build only 2.075 lineal feet of slab. Theoretically, there would be required 2,331 batches to build the mile of pavement, but on account of the bulking of sand, 2,545 batches will be required.

The extra cement used is $(2545-2331) \times \frac{6}{4} =$ 321 barrels

The sand saved is $\frac{(2331 \times 12)-2545 \times 9)}{27} =$ 187.6 cubic yards

The extra coarse aggregate is $(2545-2331) \times \frac{18}{27} =$ 142 cubic yards

The amount of bulking will be from 20 to 35 per cent, depending on the nature of the sand and the moisture present. Reference is made to *Public Roads*, dated July, 1924, citing the data regarding the bulking of sand both out on the job and in the laboratory. There are numerous other authoritative references on this subject. (See CONTRACTORS' & ENGINEERS' MONTHLY.)

Correcting for Bulking of Sand

This bulking of sand should be corrected. There are now definite and accurate methods which accomplish this. In volume measurement of sand the measure can be set sufficiently large to correct for bulking. This involves a careful watch of the condition of the sand so that correction for bulking will be consistently accurate under the varying conditions.

The weighing method has been adopted or is permitted in a number of states—California, Iowa, Tennessee, South Carolina, New Jersey, and Missouri. Under this method the batch of sand is weighed out based on the dry weight of the material without regard to the volume condition of the sand in the stock pile or cars.

A further refinement of the weighing method is to allow for the weight of water in the aggregate. This is ordinarily done by ascertaining the average moisture content of the sand. A sample of the stock-pile sand is weighed, then dried over a fire, and again weighed bone-dry. The loss in weight due to evaporation of moisture is then taken as the percentage of moisture by weight for the stock

pile. This is a simple, practical test which can be performed rapidly, without any complicated equipment and with great ease. The batch weight of sand is increased sufficiently to correct for the weight of water contained in the material.

If the stock pile varies in moisture from the average condition assumed, the error introduced is far less than where the material is being measured by volume, as the bulking fluctuates rapidly with changes in moisture content.

The weighing method has been practically applied to concrete paving operations with great success. From the contractor's standpoint, weighing of aggregate involves no delays in the operations. Equipment has been perfected for more than three years to weigh aggregates with no loss of time other than that required with a batcher.

Inundation

Within the past year the inundation system has been perfected and marketed for measuring fine aggregate in a saturated condition. Saturation automatically destroys the bulking of sand and makes it easily measured.

Inundation shrinks the sand to a constant volume basis just as if it were bone-dry and not bulked. Inundation further brings each batch of sand up to the point of saturation, thus nullifying the effect of varying moisture content of the sand on consistency. This enables the contractor to control the consistency of the concrete with greater ease. The application of the inundation system to highway paving has not been thoroughly worked out as yet, but it appears to possess enough inherent merit to deserve consideration as a means of controlling the quality and economy of concrete. The outstanding feature of the inundation system, in that it destroys the bulking of sand and insures correct water measure without any tests whatsoever as to the natural condition of the aggregate, recommends inundation to all contractors and engineers as a safe means towards preventing the overrun of materials.

Accurate Measurement of Coarse Aggregate

Correct measuring of the coarse aggregate as far as actual volume is concerned has been well taken care of. Practically all trouble encountered has been a result of the grading of the material by the producer, or, if delivered correct in all respects by him through separation of coarse and fines, has been due to improper handling by the contractor. The variation of grading in coarse aggregate also has its effect on the yield of concrete. If the cement factor is based on a normal grading of coarse aggregate from ¼-inch to 2½-inch in size, and the grading changes so that nearly all the fines or material below ¾-inch is omitted, the reduction in yield of concrete will be approximately 4 per cent. (See *Public Roads*, July, 1924, page 23.)

In actual costs this means about one-half of the overrun of materials computed under bulking of sand. Contractors have been lax in their attention to the materials delivered to them for use in concrete, particularly in regard to coarse aggregate. They have not considered the question of choice of kind, nor have they, after purchase, inspected or tested to determine for themselves whether the aggregate they are paying for does come up to the specifications under which it was purchased; neither do they give the attention to the handling of coarse aggregate that is necessary to secure the best results.

Materials passing the specifications on board cars can be changed into various gradings by handling and storing, and correct materials properly stored can be rehandled in such a way as almost to wipe out the efforts that have gone before.

This is not the right attitude necessary to prevent overrun. Contractors should insist that everything necessary should be done by their organization on a job to correct it.

Coarse aggregate is usually condemned by the engineer for other reasons than for lack of fines. Material producers know that an excessive addition of fines will cause their product to be rejected much more quickly than the lack of them. Therefore, they will play safe along that line, to the cost of prevention of overrun.

Crushed Stone or Gravel?

As to the choice between crushed stone and gravel, much has been said as to the results obtainable in their grading under present methods of production; also as to the effect of the use of either on the quantity and quality of concrete produced. This also is worthy of investigation.

As proof of the extent to which fines are lacking, one of our leading eastern state highway departments estimates that 50 per cent of the coarse aggregate for its paving work was deficient in the small sizes of material, and of course a corresponding loss was suffered in construction.

Correctness of Subgrade

In the discussion of correctness of subgrade, and its effect on overrun, it will be necessary to consider first the weather, the soil conditions, and the skill used in the completion of rough grading, as three very important factors.

Wet weather is a destructive force hanging over the entire construction process and affects overrun or underrun to a greater or less degree, depending on the soil conditions, the method of delivery of batches to mixer, the season of the year, and the duration. When hauling is done over subgrade by trucks on certain soils, the only sure way to prevent overrun or underrun is to stop the placing of concrete until suitable conditions exist, or to plank the subgrade to prevent its destruction.

Rough grading built with care, brought to as near final grade as possible, for the full width of the roadway and sufficient distance outside of form line, will tend greatly to reduce overrun. Rough grade should be kept uniformly high always, assuring that in the setting of forms they will not rest on a fill, and that all fine grade be made in cut, without the moving of excess earth. That most contractors do not draw the distinction close enough between rough grading and final subgrading is made evident by a visit to their work. Usually it is found that instead of a small force turning a well-prepared rough grade into a stretch of completed fine grade, a mixture of teams, tractors, and men are more or less rough-grading between the forms, and that all is haste and hurry, with resultant losses through faulty form-setting and subgrading.

Selection of Forms

The selection of forms suitable to meet the conditions to be encountered is very important. Forms that will serve with certain soil conditions are not fit for use on others. Selection should be made with the following qualifications in mind:

The section must be strong enough to take loads and impacts of subgrader and finishing equipment without deflection or distortion, and the area of base of form sufficient to sustain the required load upon the particular soil encountered.

The design of form must be such as to withstand the side thrust of the subgrader and finishing equipment and the lateral thrust of the concrete.

The staking arrangement should be such as to give added support to the side form over and above that provided by the subgrade by means of a locking device, a positive and effective method of fastening joints and preventing deflection at that point. The staking method and locking device between forms should also be such as to make easy readjustment possible.

Forms should be carefully set tight to line and slightly above grade before subgrading operation. If they are displaced by the subgrader, care must be used in resetting and surfacing. Usually on account of the effort necessary to remove forms and retrim directly under them, the practice is to resurface to high points by the raising of the other sections, resulting in many instances in increased thickness of slab.

Too much attention cannot be given to forms and form setting. Investigation will show that increased width and excessive or insufficient depth of slab are bound to follow lack of attention to this item. It is suggested that forms be set upon stakes driven to grade, as required by certain states.

Subgrading machines, of which there are several types, are not made for heavy excavation, as most of us have found out, but should be used for light trimming. If they are used with care, making a gradual approach by light cuts to final grade, low subgrade will be avoided, and the form line kept in almost perfect condition.

Tests should be made on subgrade to find out the amount of compression due to rolling that must be allowed for. This is important and will depend on the weight of roller required, and the soil conditions and may further be affected by the requirements of specifications as to the amount of rolling specified.

Several states require the final cut on subgrade to be made between the mixer and the place of depositing concrete. This is accomplished by attaching a special make of subgrading template to the mixer, that is pulled forward at each move of the paver.

Satisfactory results tending to correct overrun are obtained by this method if the subgrade has been left uniformly high, taking into consideration that only a very light cut can be made for final completion by the drag template. In case of low subgrade, no filling is allowed, therefore no result is accomplished other than that it is apparent that extra concrete is being placed.

As stated before, contractors must remember that there is a direct bearing of one operation upon another in the final effect on overrun and underrun of materials used and that the correctness of the subgrading operation

is the climax in the preventive action.

Miscellaneous Important Recommendations

A summary of recommendations to assist in a solution of prevention of overrun through subgrade deficiencies should include a requirement for additional footage of forms set and subgrade prepared, watered, and rolled ahead of paving operation; with requirement that all subgrade be made uniformly high and to proper section for final completion by drag template; the stopping of all hauling directly on prepared subgrade; a further refinement of the subgrading machine; changes in length of mixer boom and design of bucket to enable further development and use of drag template.

The effect of incorrect methods of mixing and finishing upon overrun and underrun is less than the other operations mentioned, and these methods are subject to correction much more readily. Consistency of concrete should be kept well within the range of a workable mixture, dependent on the ability of the finishing equipment to handle it.

Finishing machines will successfully handle concrete produced under the slump tests usually specified, if the grading of aggregate in the mix is correct, and will do so without loss over side forms. Care must be used, however, in checking the strike-off and tamper as to their correctness in crown shape with respect to the finished surface as specified, and their adjustment one to the other. This check should be continued throughout the laying of the pavement, as it is possible for the adjustment of the strike-off and tamper to become loose and drop, or for an operator in adjusting the machine to reset it higher than necessary. Also watch that the scrapers, that are supposed to clean the top of form ahead of finisher wheels, are adjusted so that they do provide a clear track for the machine.

In the operation of the finisher a regular procedure should be worked out and followed. It is the tendency to do as little with the finisher as possible. The average operator has no idea of the importance of the position he holds in its effect on overrun, and in his efforts to carry out his instructions "to keep up with the mixer," does a haphazard job of striking off the concrete.

Even the puddlers or levelers also play their part in preventing or helping overrun to occur; preventing it by careful leveling of the batches, making it possible for the finishing machine to do its work correctly, and stopping unnecessary spilling over the top of the forms; or helping it by careless leveling that forces the finishing machine to do extra work with a sacrifice of concrete in wastage and extra depth.

Few contractors have figured out the loss through overrun caused by a variation of ⅛-inch, ¼-inch, or ½-inch in thickness of pavement. When they do awaken to the facts, losses from overrun will receive concentrated preventive action.

Contractors do not want to lose sight of the fact that prevention or stopping of cement overrun means stopping of losses in the other materials as well; that the preventive action is a step-by-step process in construction, with a successful ending dependent on a knowledge of the effect of each step on the result obtained, and their connection with and importance to each other. Application of this knowledge in construction requires positive supervision and checking throughout the entire job.

Lack of information has been the cause of the attitude of the contractor towards the inspection and supervision of the engineer. The contractor, fighting for production, has viewed certain requirements only from the side of immediate cost in labor, while the engineer saw beyond to the result on materials and quality. It is through his efforts and guardianship that our attention has been called to the importance of this subject to the contractor.

ACKNOWLEDGMENT.—From a paper read before the American Road Builders' Association, Chicago, 1926.

New Domestic and Foreign Distributors for T. L. Smith

THE T. L. Smith Company, Milwaukee, Wis., has announced the appointment of the Coast Machinery Corporation, San Francisco, Calif., as exclusive distributors of the entire Smith line in the San Francisco territory. The LaLance Equipment Company, Huntington, W. Va., have been appointed distributors for southern West Virginia and the J. Z. Horter Company, Havana, Cuba, have received the appointment as exclusive distributors for Cuba.

P & H Makes Connecticut and Minnesota Appointments

THE Harnischfeger Corporation, Milwaukee, Wis., has announced the appointment of the Clark-Wilcox Company, 17 Lafayette Street, New Haven, Conn., and 786 Albany Street, Boston, Mass., as distributors succeeding the K. B. Noble Company, Hartford, Conn.

Announcement is also made of the appointment of the Wm. H. Hale Company, as distributors in the state of Minnesota, with headquarters at 607 5th Avenue, South Minneapolis, Minn.

Big Storms Delayed Building But Slightly

WINTER building in the last few years has been steadily increasing. It can be safely stated that the twelve-months building year has come to stay. Science has a great deal to do with the change in the building calendar, as the new, up-to-date building methods cause little inconvenience to the builder and workman during bad weather conditions, and the psychology of the buying public which has come to recognize these advantages is also a big factor.

Of course, a heavy snow such as those experienced during February, 1926, held up shipments for a few days, and in some cases material-men were unable to make deliveries as promptly as formerly, but it is estimated that building construction in New York did not stop more than one entire day where enclosures were up, although usual speed was not maintained, whereas, in olden times all building work would have ceased altogether at the approach of snow-storms like the ones experienced in February.

The George A. Fuller Company reported that all their jobs were enclosed at the time with the exception of two on which only excavation was being made. The two jobs were held up for only about three days each on account of snow-drifts and ground freezing.

G. Richard Davis states that his unenclosed operations were held up only from four to five days in cases where the steel was up, but on other operations where excavation was not completed, about three weeks' delay was experienced. Particularly was this true on the operation at 44th Street and Fifth Avenue, on account of being cramped for space and the steel and sheet piling being in the excavating hole.

John Lowry, on a job at West Point, N. Y., reports being held up only one day, and this was the result of the mechanics' not reporting for work, as they could not get there. On a fourteen-story job for Columbia University, New York City, he was held up for eight days, as the building was open and the bricklayers refused to work. On all other buildings which were enclosed, no appreciable let-up was experienced.

William J. Barney, of the Barney-Ahlers Construction Company, experienced little, if any, difficulty during the heavy snows, his reinforced concrete jobs having been amply protected and adequate precautions taken against cold and freezing weather during the months of November and December, 1925, and January and February, 1926.

Material dealers reported that there was only one day when they could not send out their trucks, but that on other days during the extremely bad weather and before any appreciable progress had been made on removal of the snow, the speed in which deliveries were ordinarily made was lessened and there was no assurance that the trucks when sent out would reach the job. This accounted in large part for holding up the work, as in New York City there is not sufficient storage space for materials in large quantities, and deliveries have to be made at frequent intervals to the job.

The New York Building Trades Council reported that labor was 75 per cent employed during the cold months and that they have no record of men being laid off on account of weather conditions. On the contrary, no deduction was made from the pay of any mechanic for lateness on the job, a full day's time being paid, although the mechanic might not have been able to put in his customary number of hours that day.

Notes About Distributors

Northwest Climax Representatives

THE Climax Engineering Company, Clinton, Iowa, has announced the appointment of the J. L. Latture, Equipment Company, 354 Belmont Street, Portland, Ore., as its representatives for the sale of Climax engines and power units in Oregon, Washington, and Idaho.

New Cement Block Distributors

THE Cement Block Machinery Company, 50-58 Columbia Street, Newark, N. J., P. W. Wittemann, President, has announced that the Good Roads Supply Company, Detroit, Mich., and the W. M. Pattison Company, Cleveland, Ohio, have recently been appointed distributors of National concrete block machinery.

Two New Distributors for Wonder Mixers

THE Construction Machinery Company, Waterloo, Iowa, announces the appointment of the Cunningham-Ortmayer Company, 14 Grand Avenue, Milwaukee, Wis., and the R. E. Brooks Company, 50 Church Street, New York City, as distributors for Wonder tilting mixers in their respective territories.

Wolverine Opens New Sales Offices

THE Wolverine Concrete Machinery Company, 2421 Buchanan Street., Detroit, Mich., has opened new sales offices with a Service Department in the same building, centrally located at the above address. From March 13 to 24 a special showing was held, with factory representatives in attendance. The Wolverine Company handles a fine line of concrete products machinery and general contractors' equipment.

New Miami and St. Louis Smith Distributors

THE T. L. Smith Company, Milwaukee, Wis., has announced the appointment of the I. E. Schilling Company, Miami, Fla., as distributors in Miami territory for T. L. Smith concrete mixers. The Schilling Company will handle the entire Smith line, including both tilting and non-tilting types of building mixers and the Smith 27-E paver. They will carry a complete stock of mixers and repair parts.

The appointment of the O. B. Avery Company, St. Louis, Mo., as exclusive Smith distributors in the St. Louis territory, is announced.

Placing 144-Ton Steel Girders on a New Theatre Structure

Interesting Feature of Construction on the New Paramount Theatre Building, 43rd Street and Broadway, New York City

ON February 22, a holiday in New York City, the first of eight 144-ton trusses, each 120 feet above the sidewalk, was placed in the new Paramount Theatre Building, 43rd Street and Broadway, New York City. The holiday was chosen for the lifting of the first of these trusses, as there would be fewer people around to be held back by the cordon of police reserves, for such a feat as this always brings out an unusual crowd about any construction job in New York City. The lifting was carried out without any difficulty on February 22, and the second of the trusses was lifted three days later.

The conspicuous part of the new Paramount Building will be a 33-story office building with a tower above. The building is to have an auditorium in the west portion to house a huge motion picture theatre and there must be no columns in the auditorium. The gallery will be hung from the 120-foot overhead trusses, which will also support the roof. To meet these requirements, the 144-ton steel trusses were designed and built, and they are being lifted to a height corresponding to the eighth floor of a modern office building.

It is impossible to move 144 tons in a single load through the streets of New York. The maximum load is about 42 tons, so it was necessary to haul the trusses in pieces to the spot and there rivet them together, using about 4,000 rivets per truss. Thirty separate pieces were assembled to create each truss, which is about 16 feet high.

Setting the Trusses

The trusses are to be supported at either end by columns each weighing 55 tons. After the columns were erected and braced and the truss was completely riveted and ready to be lifted, the truss was picked up by a traveler weighing 226 tons and having a 75-ton derrick at each end in addition to two 15-ton engines to operate the derricks. The traveler is 84 feet tall, and each of the derricks is 50 feet high with a 75-foot boom. The traveler moves on thirteen steel rails, five of them on one side, five on the other, with three in the middle. The rails are fastened to 12 x 12 timbers grouted into solid rock. The traveler runs on steel rollers on the rails. This traveler, which is in reality a seven-story moving platform, was specially built for the Thompson-Starrett Company, the general contractor.

The derricks have eight-sheave blocks. It it figured that the weight of the blocks plus the friction of the steel cables makes it necessary to exert a pull of about 150 tons to lift the 144-ton truss. The trusses are being lifted with great care, keeping both ends level so that neither derrick will be called upon to handle more than its share of the lifting.

It is expected that it will take about six weeks to set the eight trusses, although a single lift requires but twenty minutes. In addition to these trusses, there will be a number of 90-ton trusses to be placed sloping horizontally within the auditorium to support the balcony.

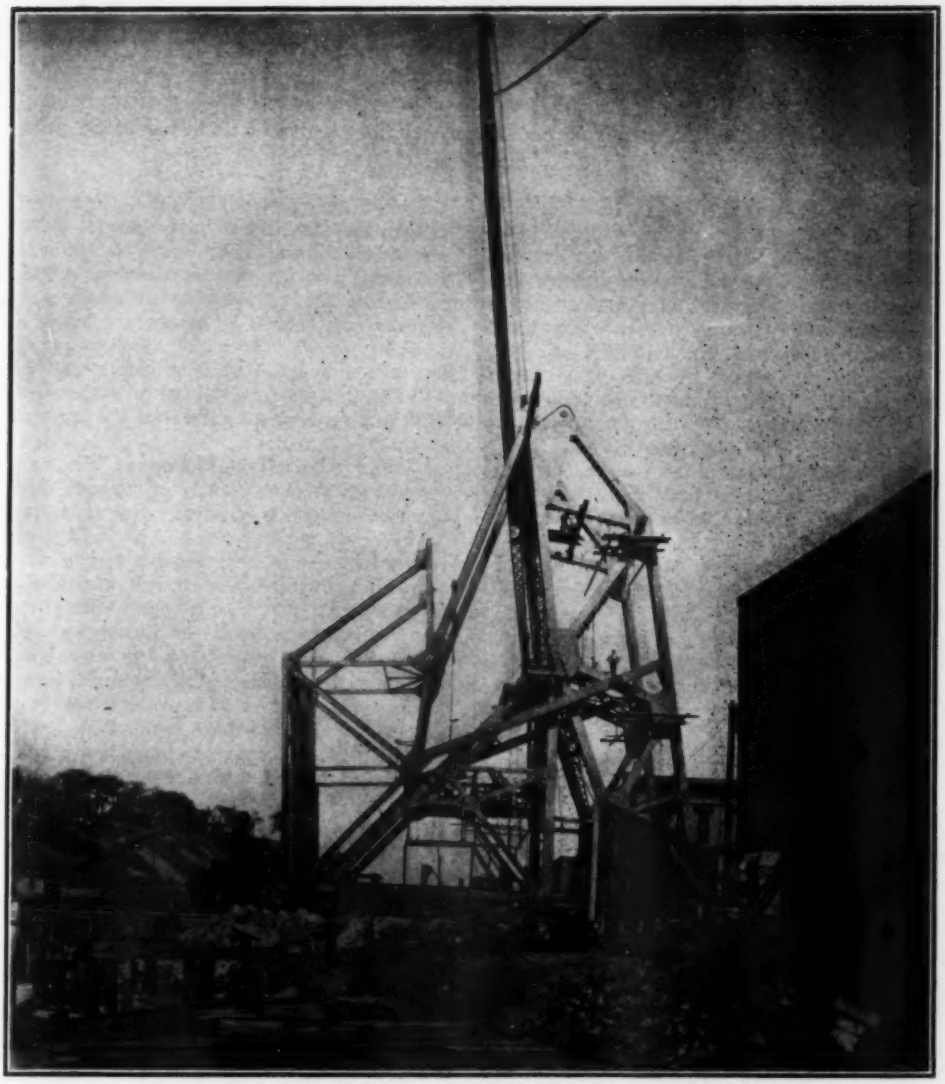
At the back of the auditorium on the 43rd Street side the gallery of the Paramount Theatre will be on a level with the sixth floor of the Times Annex, and it will slope forward to correspond with the third floor, where the first-row movie fans will sit.

Big Bridge at Busy Point Installed in Record Time

By George F. Paul

INSTALLING the new highway bridge over the river at Ashtabula, Ohio, called for quick work, as it was stipulated that traffic on this leading thoroughfare should not be interrupted for a longer period than from sunrise to sunset. This bridge is on the main highway between Buffalo and Chicago. Then, too, so many ore boats use the river that its channel could not be blocked for any length of time.

It was necessary, in the allotted time, to lower the bridge, put on the asphalt paving



ERECTING THE NEW ASHTABULA BRIDGE AT ASHTABULA, OHIO

for the floor, and at the same time place enough counterweight to raise the bridge. The bridge weighs 600 tons, and is 250 feet long, with a width of 36 feet. About 650 tons of concrete was required for the counterweight. The bridge is operated by two 50-horsepower motors. It is declared to be absolutely fool-proof because of the safety devices that have been installed. When the bridge gets to a certain point, it stops automatically, whether the operator wants it to do so or not. It is so perfectly balanced that three men out on the end of it, when the brakes are released, will lower it.

It is known as the Brown Mystic type of bridge, being so called because the first bridge of this type was built over the Mystic River, in Massachusetts. This is the second bridge of this kind. It was designed by Thomas A. Brown and Wendell P. Brown, Cleveland. The Kelly-Atkinson Company, Chicago, had the contract for the superstructure complete.

Interior Pipe and Conduit Construction in New York Cathedral

Extraordinary Pains and Expense Taken in Design and Construction of Cathedral of St. John the Divine

THE builders of the Cathedral of St. John the Divine are installing interior pipes and conduits on the same permanent and massive plan as the solid masonry which surrounds them. The architects and engineers have gone to extraordinary pains and expense to design pipes and fittings which will last practically indefinitely. Especial care is taken to make all connections accessible and to avoid the necessity of removing any stone work for repairs or for additional installations.

In planning the system of heating, the engineers are taking into consideration the probability that within 50 years this will be done by electricity. It is not known, of course, how the current will be supplied, perhaps by radio, but the electrical conduits have purposely been made of extraordinary size. The architects have attempted to devise an electrical distributing system that will give unusual durability and flexibility. The duct system is so arranged that at any time wiring can be installed for any conceivable service without disturbing or defacing the masonry. The main conduits are of fiber, 3 inches in diameter, made by the Orangeburg Fiber Conduit Company, and with special joints. As far as the architects know, fiber conduits of this kind have never been used in building construction. They have been in use for many years for underground work in cities and were designed for durability in places where metal ducts could not well be used. The ducts are being entirely surrounded with concrete, and in case the fiber itself deteriorates, the channels left in the concrete would admirably serve the same purpose.

The ducts start in the main electrical room in the basement of the Cathedral and continue through the floors of the basement, the main nave floor and at several levels throughout the height of the nave. They terminate in several extra-heavy cast brass outlet boxes set in the floor and designed to be covered by the flagging. A record of their locations will be kept by means of drawings. From these main outlet boxes the wiring may be taken to the electric light outlets through copper ducts.

Roof Drainage

The same care has been taken in designing the pipes which carry the water from the roof. Unlike the old cathedrals with their open-mouthed, dripping gargoyles, the Cathedral of St. John the Divine will have the rain-water brought down inside the heavy walls. Damage by freezing is often caused to exterior pipes, and they would also have to be carried through various parapet walls of masonry, always a source of trouble. To avoid the clogging of the drain pipes by freezing, a melting device will be built at the gutter opening, so that live steam can be turned on to melt the ice and snow.

A more detailed description of the roof water or leader pipes may be of interest. The pipe is 6 inches in diameter and of extra-heavy copper 1/3-inch thick, with fittings of heavy cast brass. Cast brass is not subject to corrosion and will not stretch or leak as would copper fittings. The pipe is coated with pitch, wrapped with 2 inches of insulation made of roofing felt and asphalt roofing and built solidly into the masonry, all sharp angles being avoided. Should these pipes deteriorate in a matter of a few hundred years, it is quite possible that the masonry openings would carry down the roof water.

Steam Pipes

Copper and brass were also considered for the steam piping, but were discarded in favor of wrought iron because of the considerable expansion the piping must stand. Furthermore, it was desired to weld all the joints in order to avoid fittings, and pipes of copper are weak at the edges of the weld.

The steam pipes are of double, extra-strong wrought iron pipe, 5/8-inch thick, with an interior diameter of 2½ or 3 inches. The steam pipes are covered with pitch, then with a thick covering of 85 per cent magnesia, and then with two thicknesses of two-ply asphaltic roofing wired on. As far as possible provision has been made for the removal and replacement of this piping.

Eighty or ninety per cent of the heat for the nave is from the radiators in the basement and these are readily accessible. The steam piping mentioned is to supply the few radiators under the windows and at higher points in the nave. Probably by the time these pipes have worn out, other forms of heating will have been devised.

The Advantages of a Combination Haul Plant on Road Work

Bad Weather and Sandy Subgrade Forcefully Show Value of Combination of Transportation Methods

By T. J. Weidner

Secretary and Treasurer, Geo. S. Mellert-Weidner Company, Medina, Ohio

THE combination of a sandy subgrade and wet weather emphasized the advantages of the combination haul plant under such conditions on one of our jobs last season in Ashtabula County, Ohio. The particular work in question was 12 miles of 16-foot concrete road with an average thickness of 7¼ inches. The job was not awarded until late in July, and inasmuch as it was desired to complete as much of the work as possible before the close of the season, it was decided to put two outfits to work.

On August 10 we started at one end of the job with our combination haul plant. A 21-E paver was used, and materials were hauled on trucks in batch-boxes from the central proportioning plant to a transfer, where the boxes were lifted off the trucks and placed on narrow-gage cars for delivery to the mixer past the green concrete.

The transfer device which we used was entirely home-made, and designed by L. J. Westland, who acted as superintendent of the work. The transfer consists of an "I" beam across the road carried on two "A" frames. A hoist carried on a trolley on this "I" beam was operated by a Ford engine placed at one end of the transfer, as shown in one of the illustrations. The entire transfer cost about $1,000 and proved to be quick and economical. We could transfer a box from trucks to cars or vice versa in a little less than one minute.

At the beginning of operation the mixer started at the transfer point and about two miles was laid when the transfer was moved ahead as far as the concrete was cured sufficiently to allow trucking over it. As the work progressed, the transfer was continually moved ahead so as to allow trucking over the new concrete as far as it had been opened to traffic.

TRANSFER POINT, SHOWING SHIFTING OF BATCH-BOXES FROM MOTOR TRUCK TO INDUSTRIAL RAILWAY TRAIN

Our haulage equipment consisted of Lakewood track, cars, and batch-boxes, together with two 7-ton Plymouth locomotives. On the maximum haul we used three trains which consisted of eight cars and sixteen boxes.

Comparison of Haulage Methods

As a direct basis of comparison, we started on August 20 with another outfit on the same job. This outfit was identical with the first one as far as the subgrading, mixing, and placing equipment was concerned, but the hauling was done entirely by trucks. A large portion of the subgrade was sandy, while in

INDUSTRIAL TRAIN HAULED BY PLYMOUTH LOCOMOTIVE DELIVERING BATCH-BOXES TO MIXER

other places it was entirely of clay. Very often it was necessary to plank over the sandy subgrade for the trucks because even the light trucks would almost bury themselves, necessitating rebuilding the subgrade and even resetting the forms. The sections of clay subgrade were particularly bad in wet weather and a great many rainy days were encountered.

It was necessary to shut all of the work down before it could be completed, on account of cold weather setting in. However, the combination haul plant, which started work August 10, completed seven miles. The motor truck outfit, which started work only ten days after the combination plant, completed three miles.

In comparing these figures, it must be remembered again that the condition of the weather and subgrade were such as to make the truck haul plant difficult to operate but did not affect the combination haul plant.

Why the Combination Haul Won

There is no question but that the combination haul outfit in the majority of instances will give greater production than the truck haul outfit for the same length of time. The reason is that the combination plant, where all hauling is done over good roads and with narrow gage, is not compelled to shut down because of weather conditions to the extent of the truck haul outfit.

Naturally, the gain in production with the combination haul plant, due to the greater time it will work, will be affected by the weather encountered and by the character of the subgrade over which hauling is done. It is true that sometimes conditions might be encountered where a truck haul plant would show to just as good advantage as the combination outfit. For instance, if a new road were being built over an old macadam base, the delays to the trucks from weather would not be so serious. Again, a season might be encountered with very few rainy days. But all in all, comparing one against the other for average conditions, it can be said with positive assurance that more working days per season can be expected from the combination plant.

There are certain other factors which make the combination haul plant a producer of better profit to the contractor. There is a saving of material because with the combination plant it is possible to maintain exactly the required depth of subgrade. With the truck plant, the subgrade once prepared is rutted and cut up, making retrimming necessary, increasing the amount of concrete required, and adding to the labor costs. Neither is it possible to keep the subgrade as well rolled, the rolling operations being interfered with by the passage of trucks. Again, with the combination haul plant, forms once set are not disturbed by trucks crowding them up or out of line. Roads can be built smoother, with less hand work behind the finishing machine as a result, and the work can be done cheaper and better.

As a result of our own experience with trucks and narrow gage, we are firmly convinced of the economy and advantages of the latter.

Better Concrete Roads

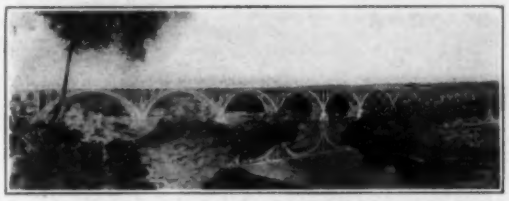
THE National Lime Association, 918 G Street Northwest, Washington, D. C., has issued a new Bulletin 314 which discusses the question of better concrete roads. This illustrated booklet is prepared from material secured from a number of highway jobs and shows that 4 to 7 per cent of hydrated lime by weight of the cement makes a better concrete road. Concrete containing hydrated lime may be placed with less water, avoiding segregation, and will shape up to give a better-riding road. The advantages of lime are well supported by test data and letters from contractors and engineers who have used lime in their street or highway construction in many sections of the country.

This 5 x 9-inch, 20-page booklet may be secured from the National Lime Association direct without cost.

Sectional Steel Centering Used on New Mendota Bridge

Structure Claimed to Be the Longest Concrete Arch Bridge in the World, Under Construction Near St. Paul, Minn.

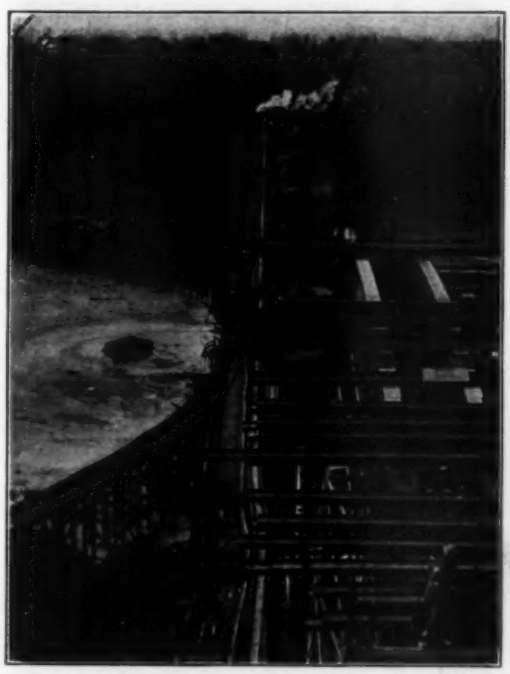
ONE of the largest and most interesting improvements now under way in the Central States is the Fort Snelling-Mendota bridge spanning the Minnesota River Valley and connecting Minneapolis and St. Paul with the town of Mendota and the Jefferson Highway on the south. The north approach of the bridge runs through the Fort Snelling reservation, which was purchased from the Indians in 1805 by Zebulon N. Pike for $200 worth of beads, hatchets, and calico, and 60 gallons of firewater. Liquor is more expensive today and scarcer than it was in those days, but one would need a lot more to buy nine square miles of territory touching on the Twin Cities today, because of their tremendous commercial development.



ARCHITECT'S DRAWING OF THE COMPLETED BRIDGE

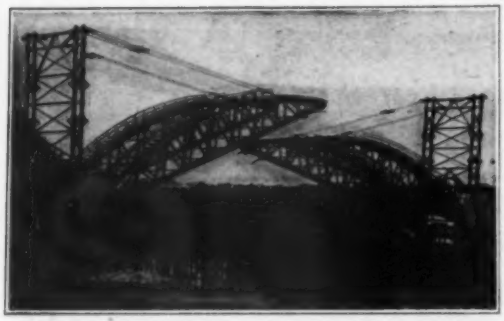
The new Mendota Bridge, which replaces an 80-year-old ferry, will consist of 13 open-spandrel ribbed arches each 304 feet long, with two ribs to each arch and with slab approaches at the Fort Snelling end. It will be 4,119 feet long and 60 feet 8 inches wide, and the roadway will be 125 feet above the water-level of the Minnesota River.

Each of the twelve piers under the main span rests on four concrete caissons, which were sunk to bed-rock as concrete cylinders, built a section at a time. After they were sunk to solid bearing on bed-rock, the mud was dug out of the center with an orange-peel bucket handled by one of three American locomotive cranes, and then the hollow center of the caisson was filled with concrete, making a solid pillar 14 feet in diameter. (See CONTRACTORS' & ENGINEERS' MONTHLY, February, 1925, page 53.)



CONSTRUCTION VIEW FROM THE TOP OF THE BLUFF ON THE MENDOTA (SOUTH) END OF THE BRIDGE

The four caissons forming the foundation of each pier are tied together at the ground level with heavy concrete web walls. At the bottom the caissons are 22 feet in diameter, outside measurement. Thirteen feet from the bottom is an offset of 4 feet all around, and from the offset to the top the caissons have an outside diameter of 14 feet and an inside diameter of 10 feet, the walls being 2 feet thick. This enlargement at the bottom provides a broad bearing pedestal on the solid bed-rock to which they are sunk. They were sunk by the open dredge method. A steel cutting edge was attached to the structural steel framework on the bottom sections of the caissons. As the excavation proceeded and the caissons sank under their own weight, the sinking was con-



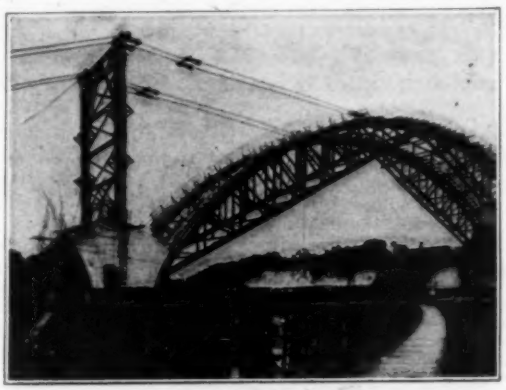
THE STEEL ARCH CENTERING BEING RAISED INTO POSITION

trolled by three American hand power winches of 72-ton capacities on their 9-part lines. The sinking caissons were held in line by ⅞-inch steel cables fastened with Crosby clips. As each portion was sunk to the ground level, another section was poured on top of it, sectional steel forms being used.

The caissons, each weighing 320 tons, were sunk to an average depth of 70 feet below ground level to solid bed-rock. As they sank, the locomotive cranes, working with orange-peel buckets, excavated the mud forced up through the hollow centers. This allowed water to run into the bottom and keep them full. It was necessary that the progress at the bottom be inspected frequently, but it was found that pumping out the water to permit inspection caused the mud to come in from the sides. It was therefore necessary to hire a professional diver to do the work. The diver would go down into 70 feet of muddy water on a ladder, make his observations, and then report them upon returning to the surface. Acting on the information furnished by the diver, they effectively directed a water-jet to assist in the sinking of the caissons. When the diver was not needed for diving, he did mechanic's work, in which, according to the men in charge, he was as efficient as in diving.

The finding of a sloped bed-rock surface at the base of one set of four caissons necessitated the forcing of cement grout with compressed air through pipes to build up an even bearing for the caissons.

Work has now progressed very rapidly on arches 11, 12, and 13. The interchangeable arch centers are now in position for arches 9 and 10. The huge proportions of the Mendota bridge may be visualized from the fact that structural steel is employed instead of wood for the arch centers which support the superstructure during construction. A complete set of these steel arch centers weighs 400 tons. There are three complete interchangeable steel arch centers.



ALL READY FOR THE CENTER PIN
When the pin was in place, the two 60-foot bents on the pier skewbacks were removed

THE 2½-INCH BACK-STAY CABLES OF ONE OF THE TOWER BENTS

Erecting Steel Arch Centering

The accompanying illustrations show the methods of erecting the arch centering. Each quarter of the steel centering is placed separately in a horizontal position. The four quarters then are lifted simultaneously by eight sets of American block and falls operated by electric winches of the same make. The

STEEL CENTERING AND WOODEN FORMS IN PLACE ON NEAREST ARCH

lines lead up to the tops of 60-foot timber bents which are strengthened with truss cables fastened with Crosby clips and which stand on the skewbacks of the two piers which are to support the arch. After the four quarters have been lifted to the required height, a center-pin is placed in position and the winches slack off until the pin carries the load. Eight special American electric winches with increased gear ratios and 18-inch diameter drums, which will hold 500 feet of ⅞-inch cable, are used to swing up the four quarters of each set of arch centers simultaneously. Four of them are placed on each of the two piers on which the arch centers are to be placed, two raising each quarter. They each have a single-line capacity of 11 tons and work through eight-part American block and falls with 18-inch outside flange diameter sheaves which are fastened to the top of the bents. A 2½-inch cable extends from the lower block to a large-diameter equalizer sheave fastened to the end of the quarter-section away from the pier, and then back to the other set of block and falls. In this way the two winches swinging up each quarter carry equal loads; as they each have a single line capacity of 11 tons and work through eight-part block and falls systems, their combined capacity is 176 tons. Each quarter of the steel arch spans weighs 100 tons, so that there is a large factor of safety.

The 60-foot wooden bents on the pier skew-backs are prevented from being pulled forward by means of 2½-inch back-stay cables running back from the upper four blocks to the next pier behind. Only two long cables are used, instead of four. Each of them runs through a large-diameter equalizer sheave securely bound with cables, fastened with Crosby clips, to the piers used for anchoring. The two ends of each are fastened to the two upper blocks on each side of the bent above.

With the steel arch centering in place, wooden forms are placed on it and the concrete poured. When the concrete has set, the arch centers are lowered by reversing the operation just described, skidded out one quarter at a time on special trucks on the temporary trestle track by means of two sets of five-line blocks and tackle at the ends of each quarter, operated by hoisting and closing lines from the boom end of one of the locomotive cranes. The quarters are then pulled along the trestle, one at a time, to their new location by one of the locomotive cranes, clamped to the track and operating a block and tackle direct from the front drum. They are then skidded into their positions in readiness for being raised into another steel arch center by reversing the operation of skidding them out onto the trestle from their previous location. There are three sets of these steel arch centers.

The Mendota Bridge will weigh about 148,000 tons, will contain 75,000 cubic yards of concrete, and will have about 300,000 square feet of concrete surface. It is estimated that approximately a million feet of lumber will be required for the falsework. A million feet of timber did go into the temporary working trestle which runs parallel with the line of the bridge for its entire length. Most of the piles that went into this trestle are 70 feet long and have a penetration of 40 feet. The trestle carries two tracks, a standard gage for the three American locomotive cranes, and a narrow gage for the dinkey train which hauls the concrete out to the cranes from the concrete supply hopper which is on the level of the

TWO AMERICAN LOCOMOTIVE CRANES TAKING DOWN THE FORM WORK

working trestle. The mixing plant is at the top of the bluff at the Mendota end of the bridge, and concrete is chuted down to the supply hopper.

The Koss Construction Company, Des Moines, Iowa, was awarded the contract for the Mendota Bridge at $1,700,000, and work was begun May 1, 1924. The construction is right up to schedule, and the structure will be completed about October, 1926. Frank Kratoska is Superintendent of Construction for the Koss Construction Company, W. H. DeButts is Resident Engineer, R. S. Parker, Material-Man, and F. Weddel, Chief Clerk.

New Sales Manager for Plymouth Locomotives

THE Fate-Root-Heath Company, Plymouth, Ohio, has announced the appointment of Lawrence E. Buzard as General Sales Manager, succeeding H. R. Sykes, who recently resigned. Mr. Buzzard, who was formerly Assistant Sales Manager, has been with the company a number of years and is thoroughly conversant with industrial haulage problems. He will have direct charge of locomotive sales and 34 district sales representatives.

Institute of Quantity Surveyors

AN Institute of Quantity Surveyors is now under organization by representative professional quantity surveyors throughout the United States. The initial session of the Institute will be held at Chicago June 7, 8, and 9, 1926. Those interested should communicate with G. Szmak, Universal Engineering Company, 945 Main Street, Bridgeport, Conn.

Warren Brothers Move Office to Cambridge

WARREN BROTHERS COMPANY has announced the removal of its executive offices and laboratory to 38 Charles River Road, Cambridge, Mass., telephone, Porter 4321, and mail address, P. O. Box 1869, Boston, Mass. The new office is quite near the plant and also near the Kendall Square Station of the Cambridge subway.

NEGOTIATING A 30-DEGREE GRADE A LA CRAB

The Industrial Type-DC shovel shown above had to negotiate this grade in the course of its work. The shovel backed up the grade because of the location of the gasoline tank. This Industrial shovel is powered with a Climax Model TU 5½ x 7-inch, 4-cylinder engine, developing 77 horsepower at 1,200 r. p. m.

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street Attorney-at-Law

Computing Time Provisions—Occupancy as Acceptance

A contract for the erection of a building to be completed within "90 days from the date of this contract" was lately held by the South Carolina Supreme Court to require inclusion of Sundays and holidays in computing the period. (Leonard vs. Atkinson, 130 Southeastern Reporter, 755.)

In the same case it was held that the mere fact that an owner occupies a building does not necessarily constitute an acceptance of it as conforming to contract requirements. The owner is entitled to show, if he can, circumstances negativing an acceptance.

Delays in Completing Contract Work

A New Jersey building contract provided that the contractor should be allowed an extension for any time lost through the act, neglect, or default of the owner or any of the owner's representatives. But it was specified that "no such allowance shall be made unless a claim therefor is presented in writing to the architect within 48 hours of the occurrence of such delay." Applying this clause in the case of Commercial Investment Company vs. Herman, 131 Atlantic Reporter, 223, the New Jersey Court of Chancery decided that the contractor was not entitled to an extension of time on account of the owner's failure to select face brick, where no written claim had been presented.

Another section of the contract provided for liquidated damages at the rate of $100 for each day's delay in completing the work beyond a fixed date, but that "should any strikes or conditions arise beyond the control of the contractor, time is waived from this contract." Under this part of the contract, it was decided that the contractor was not required to make a claim in writing for an extension of time because of delay in steel deliveries.

The clause providing for $100 per day damages being reciprocal in the contractor's favor, by entitling him to $100 for each day the work should be completed before the date fixed in the contract, the Court held that it was reasonable and binding.

Contractor's Liability for Injury to Property

A street improvement contract called for removal of an old concrete bridge and construction of a new one. Carefully using dynamite to remove the old structure, pipes of a water company, which were embedded in the bridge, were destroyed. The company sued the contractors for the cost of replacement. Holding that no valid claim against the contractors was pleaded, the Appellate Court of Indiana declared in the case of Singer vs. Washington Water, Light & Power Company, 149 Northeastern Reporter, 918:

"Corporations, such as water and gas companies, which receive franchises to lay pipes in streets, take the granted privileges subject, in so far as the location is concerned, to such future regulations as may be required in the interest of the public welfare. . . . As said by the Supreme Court of Florida . . . :

"'A water company, placing its pipes in the streets under a franchise contract with the city, does so in subordination to the superior rights of the public, through its duly constituted municipal authorities, to construct sewers in the same streets, whenever and wherever the public interest demands; and if, in consequence of the exercise of this right, the water company is compelled to relay its pipes, in the absence of unreasonable or malicious conduct, it has no cause of action against the corporation for reimbursement on account thereof.'"

The Indiana Court ruled that the water company, having had notice of the projected improvement, was bound to take such steps as it desired for the protection of the pipes; and that in the absence of negligent injury, the bridge contractors were not liable for injury to the pipes resulting from removal of the bridge.

Transportation as Part of Employment

A contractor's employee while proceeding to his place of work, with co-employees, accidentally fell from the truck and was fatally injured. Question arose as to whether or not the accident arose out of and in the course of his employment, in such sense as to make the employer liable under the Connecticut Workmen's Compensation Act. The Connecticut Supreme Court of Errors decided that the accident was covered by the law, saying, in part:

"These employees were not informed of the relations between the owner of such truck and the defendants, in relation to their transportation. Under the facts found, the employers arranged for their transportation. Whether this was arranged for by pay to the truckman, or by the gratuitous willingness of the truckman to do a favor to his employer, was not disclosed to the workmen. The employers did not specifically contract with the workmen to transport them, but assumed the obligation to transport them by directing the deceased and other employees to ride on this truck, and by their knowledge of the continued practice of the workmen so to ride, and not interrupting it.

"It is true that the actual employment of these workmen for stated pay did not begin until they arrived on the job and began work, but when an employee mounted the truck at the employers' direction to go to the job. . . . he came within the zone of his employment as contemplated by his employers." (Saba vs. Pioneer Contracting Co., 131 Atlantic Reporter, 394.)

Your Cost of Material Handling Goes Down When You Put Bull Frog Barrows on the Job

This Bull Frog No. 42 not only sets a new standard of durability, but embodies many distinctive engineering features that set a new standard for wheelbarrow efficiency. Note the elevated front of the seamless tray that carries a full load without spilling. The tray is always level when the handles are raised. The angle iron wheel guard loop permits forward dumping without straining the frame. The shaped handles and the Never-Break easy-running wheel make for easy handling. Here is the outstanding general purpose barrow of the year. It can be used for either wet or dry materials.

Ask your jobber or write us for specifications, prices, and catalog showing Bull Frog barrows, carts, and scrapers for every mine, foundry, factory, building, public works, and construction purpose.

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Toledo, Ohio

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Contractor's Surety's Rights on Taking Over Property

In the case of United States Fidelity & Guaranty Company vs. Worthington & Company, 6 Federal Reporter (Second Series), 502, the United States Circuit Court of Appeals, Fifth Circuit, lately passed upon the obligations of a highway contractor's surety to the contractor on taking over work abandoned by the latter. The Court decided that when the surety took over the work for the purpose of completing it, including the contractor's equipment, materials, e.c., the surety became bound "to complete the work as reasonably as possible, and without profit to itself." The surety could exercise discretion as to how this was best to be accomplished. But its taking over of the work must be deemed merely for the purpose of indemnifying itself against loss. That being accomplished, the contractor is entitled to whatever is left.

Building Contractor's Right in Obstructing Traffic

An opinion of the Wisconsin Supreme Court recognizes that a building contractor may become liable to a near-by property owner for loss of business due to unreasonable obstruction of a street or sidewalk in erecting a building. (Trester & Tresler vs. Kahn, 205 Northwestern Reporter, 826.) The case involved erection of a building in the heart of the business district of Milwaukee. But the opinion shows that a contractor has broad rights to temporarily use a street for reasonable deposit of material, etc.

The Court declared that defendant, the contractor, "must be held to be acting for and on behalf of the owner, and to have the same rights in the public streets adjacent to the property that the owner would have if the owner himself were engaged in the work. . . . An abutting property owner has a right to deposit building material and earth in the adjoining street; such right, however, being limited by reasonable necessity to be determined in the absence of municipal regulations by the circumstances of each particular case. . . .

"It has been held that, where the right to occupy the street with materials in the course of building operations has been regulated by valid ordinance, a permit issued pursuant to such regulation is a protection to any person acting under it without negligence. . . .

"Whether a permit which authorized an unreasonable obstruction to public travel would be valid is another question. Whether the use made of a street in the particular case is reasonable or unreasonable is a question of fact, depending upon the width of the street, the size of the building being erected, the amount of traffic to be accommodated, and any other facts and circumstances which affect the situation.

Validity of Promises to Pay Another's Debt

In most, if not all, of the states there is in force a statute which, in effect, declares that an oral promise to pay a third party's debt is unenforceable. But a decision of the Massachusetts Supreme Judicial Court (Pope & Cottle Company vs. Wheelwright, 133 Northeastern Reporter, 106) shows that there is an important qualification in the application of the statute.

The Court held that an owner's agreement to pay a material-man for materials delivered to a contractor for use on the owner's building was an original undertaking in consideration of which the contractor was released from liability, and therefore not covered by the statute. It seems that the materials were first charged to the contractor, and the statute would have applied if there had been a mere promise on the owner's part to pay the contractor's debt. But, in line with what other courts have decided, the Massachusetts Court ruled that release of the contractor from liability was sufficient consideration to support the owner's agreement that he be substituted as debtor.

A similar qualification applies where material is delivered to one person and charged to another, with the latter's consent. There, too, the obligation to pay is treated as original, and not as such promise to pay the debt of another as must be reduced to writing and signed by the party to be bound before it is valid.

Contractor's Right to Substitute Materials

Unless a contract specifying use of certain materials expressly permits the contractor to substitute another kind, the owner is entitled to insist on the letter of the agreement, even though other materials may be "just as good," according to the decision handed down by the Georgia Court of Appeals in the case of Maner vs. Clark-Stewart Company, 109 Southeastern Reporter, 178, where it was declared:

"Where a contract provides that a job shall be done by the use of specified materials, the owner for whom the work is to be done and for whom the material is to be used is entitled to stand upon the express terms of the agreement; and the fact that other and different materials, which were to some extent substituted, may be shown to have been just as good as those specified by the contract, or that it was usual and customary to thus make use of other materials in good and workmanlike jobs of similar kind, would not be sufficient to show a substantial compliance with the terms of the contract, but, upon proof of such a variation therefrom, the owner would be entitled to damages."

Conditions Implied in Contractor's Favor

The legal principle stated by the California Supreme Court in the case of Gray vs. Bekins, 199 Pacific Reporter, 767, applies to all sorts of construction contracts, as well as to building contracts:

"In every building contract which contains no express covenants on the subjects there are implied covenants to the effect that the contractor shall be permitted to proceed with the construction of the building in accordance with the other terms of the contract without interference by the owner, and that he shall be given such possession of the premises as will enable him to adequately carry on the construction and complete the work agreed upon. Such terms are necessarily implied from the very nature of the contract, and a failure to observe them, not consented to by the contractor, constitutes a breach of the contract on the part of the owner entitling the contractor to rescind, although it may not amount to a technical prevention of performance."

Power Shovel for Underground Work

Standard Type Shovel Equipped with Electric Motors Working on Subway Construction

A TYPE of power shovel that is likely to be useful under cramped conditions is the new Marion standard type 21 with bow type boom. This shovel has been developed particularly for tunnel work. It can operate underground in only 11 feet of headroom. The Marion Steam Shovel Company, Marion, Ohio, manufacturers of this shovel, state that because of its short boom and dipper stick and the consequent shortness of its swing, it can load cars with great rapidity.

The Marion electric thus equipped and shown in the accompanying illustration is owned by the Oakdale Contracting Company, Brooklyn, N. Y., and is being used in connection with its Brooklyn subway contract. This shovel, which loads cars at grade, has handled a tremendous yardage within the cramped confines of the subway cut.

It is interesting to note that by the use of special booms like the one shown, standard types of power shovels can be utilized underground in deep cuts, in cramped surroundings, and still be depended on to handle a big output daily. The conversion from the standard boom to the bow type boom requires no change from the standard operation, the same controls being used as with the conventional type of boom.

MARION ELECTRIC SHOVEL WITH BOW TYPE BOOM WORKING ON BROOKLYN, N. Y., SUBWAY CONTRACT

Studies of Bonds Between Concrete and Steel

UNDER the direction of Professor Duff A. Abrams at the Structural Materials Research Laboratory, Lewis Institute, Chicago, tests have been made of the bond between steel and concrete. The results were printed in the 1925 Proceedings of the American Society for Testing Materials and are of particular interest to contractors and engineers.

Bond tests were made by applying a pull at one end of 1-inch plain round steel bars embedded axially in 8- x 8-inch concrete cylinders. Parallel compression tests were made on 6- x 12-inch concrete cylinders. The concrete covered a wide range in quantity of mixing water, cement, and size and grading of aggregate. Tests were made at ages of seven days to one year. In all, 735 pull-out bond tests and 735 parallel compression tests were made. The principal conclusions from the tests are:

1. Slipping of the bar began at a bond stress of about 10 to 15 per cent of the compressive strength of the concrete, but considerable additional load was taken before the ultimate bond resistance was reached.

2. An end slip of bar of 0.0005-inch occurred at 55 to 60 per cent of the maximum bond. For mixtures leaner than 1:1 the maximum bond was about 24 per cent of the compressive strength of the concrete, and came at an end slip of about 0.01-inch, regardless of the characteristics of the concrete.

3. Bond and compressive strength increased with the age of the concrete from seven days to one year. For 1:5 concrete of water-ratio 0.88, the bond at one year was 134 per cent of the 28-day value, and the compressive strength was 148 per cent.

4. The bond responded to changes in water-

ratio of the concrete in much the same way as compressive strength; increase in water-ratio, due to the use of wetter concrete, less cement, or an excess of fine aggregate, resulted in material reductions in both the bond and the compressive strength.

5. For mixtures richer than 1:1, the bond fell off, probably because of the greater volume changes during hardening, which is characteristic of such mixtures.

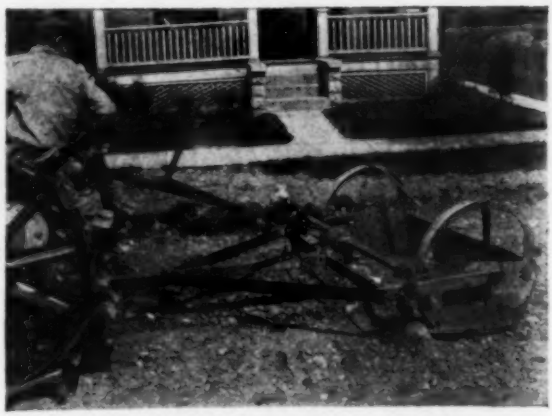
6. The use of 4 per cent of the 28-day compressive strength of concrete as the working stress in bond for plain bars, as specified by the Joint Committee, is justified. This gives a factor of safety of 2½ to 3 against first slip.

7. The use of crude oil to replace mixing water in general caused a reduction in both bond and compressive strength of concrete, due probably to the lubricating effect of the oil. Replacing cement with hydrated lime also decreased the compressive strength and the bond about 1.2 per cent for each 1 per cent of hydrated lime in terms of volume of cement, or about 2 per cent for each 1 per cent by weight.

A Well-designed Automatic Scraper

A Speedy and Economical Dirt-Moving Unit

AN automatic scraper which is built for use with the tractors, and which fills, hauls, and dumps with the tractor in continuous forward motion without any stopping or backing, has been developed by the Perry Company, Sidney, Ohio. By means of a conveniently located lever, the tractor driver easily controls every movement of the scraper. In filling, he can vary the depth of cut as desired, making a deep or a shallow cut. In unloading, he can dump in a heap or spread to grade.



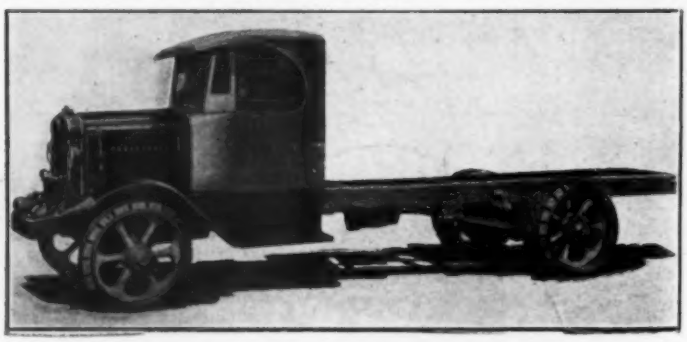
A PERRY SCRAPER PICKING UP ITS LOAD

The scraper is built with ample strength without excessive weight. All steel bars and plates are of special analysis, high in carbon and manganese, and all castings are of electric steel. The parts have been standardized as to size and location of holes and are completely interchangeable. Wherever possible, rights and lefts have been eliminated, thus simplifying the repair problem and making it easier to carry stock, and reducing the liability of error in shipment.

Trucks for Extra-Heavy Duty

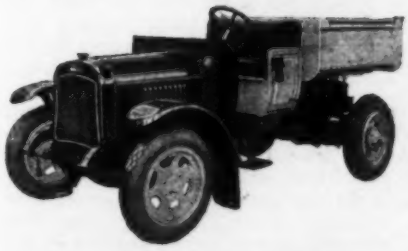
Many Refinements and Heavier Construction Are Features

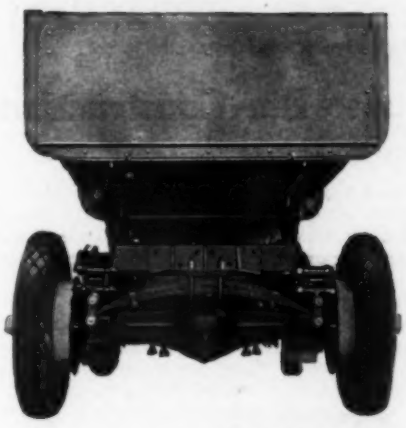
NEW heavy-duty trucks designed to adequately care for the increasing hauling problems of municipalities and contractors are announced by the General Motors Truck Company Pontiac, Mich. The need of every type of service requiring sturdy and powerful trucks was thoroughly studied by competent engineers, and their findings were used as the basis of the mechanical and engineering design of the new trucks. Two of the models, the 5-ton and the 3½-ton, have been named



THE GMC BIG BRUTE 5-TON TRUCK CHASSIS

It's Built for Abuse





Getting in and out of gravel pits—pulling through soft ground easily—turning around in smallest places—making more trips per day and doing it regularly every day—that's what this RUGGLES Model 22G Dump Job is built for.

It is equipped with a steel dump body—operated automatically—has a gravel capacity of 36 cubic feet—a wheel base of 111 inches and the special feature of cantilever springs suspended across the rear in addition to extra heavy side springs.

Road Contractors should examine this Dump Job—first, because it is exceptionally rugged; second, it is unusually fast and, third, it is designed to do more work at a lower cost.

Ruggles Road Builders are also built in larger sizes as follows: Model 41D with a gravel capacity of 45 cubic feet and Model 40HRB with a gravel capacity of 66 cubic feet. Write us for detailed information.

Ruggles Motor Truck Company
Saginaw, Michigan, U. S. A.

RUGGLES
ROAD BUILDER

"Big Brute," as typifying their strength. The third model, the 2½-ton, has been designed along lines that produce fleetness combined with strength. All three models contain new mechanical and engineering achievements. Electric starter is standard on 1-ton and 1½-ton models.

Investigation showed that there were four fundamentals in truck construction being demanded by truck users. These are power, accuracy of construction to eliminate need of frequent repairs, design that permits easy and quick servicing, and ease of operation which produces efficiency.

Added power has been supplied in these new GMC trucks, and new manufacturing methods have permitted even finer limits of accuracy. Several new features of design have been added to further increase the ease of performing necessary service operations. These not only reduce upkeep cost, but also shorten the time a truck is withdrawn from work. Truck-driver comfort and ease of operation were points long overlooked in truck design, and it was also not appreciated until recently that comfort adds greatly to the truck's operation. To meet this demand, an all-steel cab was designed by the Fisher Body Corporation in collaboration with General Motors engineers, and is used as standard equipment on all heavy-duty trucks. This cab is rattle-proof, has a one-piece, full-vision ventilating wind-shield and a comfortable spring seat, and is equipped with sliding doors and sliding curtains, providing complete protection against the worst weather.

Among the mechanical improvements are the new metal used in the removable cylinder walls, which gives greater hardness and wearing quality, double honing, which completes the mirror-like finish of the walls, lapped piston pins, new metal alloys for the valves, and a special "coining" finish which improves their wear and reduces noise.

The new models are fully equipped. The electrical equipment includes batteries, generator, head, dash and tail lights. Heavy steel bumpers, sheet steel fenders which extend from the bumpers back to the running-board, radiator guard cross-bar, automatic windshield wipers, two hooks and license-plate holders, as well as the new Fisher built cabs, are standard equnipment on all models. Over-size tires provide better traction and cover all legislation requirements.

A New Development in Batcher Bin Construction

A Trailer Type Unit Developed for Building and Road Contractors

CONSIDERABLE interest has been aroused on the part of building and road contractors by the new trailer batcher bin which has been developed by the Heltzel Steel Form & Iron Company, Warren, Ohio. The construction of this bin is such that it can be moved, completely assembled, by two men without the removal of the batchers. It has been transported over highways for distances of more than 60 miles and through congested city traffic at an average speed of 10 miles per hour.

The bin is shipped completely assembled on drop-end gondola cars and is easily unloaded or reloaded without the use of a crane. It has a riveted connection which fastens onto the frame of any make of truck. Its use is said to save from three to four days on every move and set-up.

The automatic single-control batcher works speedily, efficiently, and accurately. It is controlled by a single lever, which performs the complete operation of filling, cutting-off, dumping the batch of sand and stone, and closing the lower gate and opening the upper gate in less than 10 seconds. It has a batch speed of six batches per minute.

TRANSPORTING A HELTZEL TRAILER BATCHER BIN

MARION SHOVEL DOING ITS PART TO MAKE THE SESQUICENTENNIAL A SUCCESS

Landscaping for the "Sesqui"

Mobile Excavating Equipment Found to Be a Necessity

PREPARATIONS for the Sesquicentennial Exposition to be held in Philadelphia June 1 to December 1 this year to commemorate the 150th anniversary of the signing of the Declaration of Independence are now well under way. One of the early problems is, of course, that of landscaping the extensive grounds. A great excavation is involved, but it is scattered over a large area. This means that excavating equipment of a highly mobile character must be used.

A tract of land comprising about 2,000 acres is being utilized. It is being prepared for properly setting off a number of imposing buildings, including three great exposition halls with an aggregate of 25 acres of floor space, a stadium to accommodate 150,000, and an auditorium which will seat 20,000.

As just one of the features of the grounds involving excavation, there will be 12 acres of lagoons. The character of the excavating work is shown in the accompanying photograph, which shows a Marion steam shovel of 1¾ yards capacity, made by the Marion Steam Shovel Company, Marion, Ohio, on the job. This shovel has shown that it can operate rapidly and has exceptional ability in getting around the grounds easily and quickly for a power shovel. It does this under its own power.

Payment for Materials Stored on the Job

IT is most encouraging to see the results accomplished by the Ohio Contractors Association in its recent efforts to secure payment for the contractor for materials stored on the job. Back in December the Department of Highways of Ohio issued an order to the effect that no estimate would be allowed on stored cement during the winter months. Through the efforts of the Ohio Contractors Association, a modification of this order was secured allowing the contractor 75 per cent of the value of any stored cement in substantial quantities.

A more complete explanation of the circumstances surrounding this incident is found in the Bulletin of the Ohio Contractors Association commenting as follows:

"We are glad to be able to report that the Department of Highways has modified its previous order, and instructions to that effect should be in the hands of the Division of Resident Engineers by the time this bulletin reaches the members. Estimates will be allowed at once on substantial quantities of cement in storage where an inspection by the department engineers shows that the same is properly stored, so as to avoid any unusual hazards. The amounts allowed will be 75 per cent of the value instead of the 90 per cent allowed on less perishable materials. The modification follows the submission of our letter and a succeeding conference with the Department engineers, and was responsive to facts and arguments submitted by the Association. In view of the surrounding facts and circumstances and the character of the material in question, no fault can be found with the fixing of the percentage at 75 instead of 90."

The Kentucky Association of Highway Contractors seven months ago endeavored to effect an understanding with the State Highway Commission of Kentucky on the payment of material stored on the job, but not incorporated in the finished work. The recommendations of the Asso-

ciation are now being considered by the Highway Commission, and some hope is held for the institution of such payments. This plan has been put into effect in many other states and is also considered general practice in private construction work. Such railroads as the Illinois Central, and the Louisville and Nashville, allow estimates on stored materials, and in building work a majority of architects have adopted the plan. Its soundness from an economic standpoint cannot be questioned. If the contractor receives payment for material stored on the job, it enables him to prepare during the winter months for the working season, thus reducing his overhead expenses and consequently the cost of construction. This means lower bids for the state and an additional saving by the earlier completion of the road, together with convenience to the motorist.

Building Motor Trucks for Heavier Duty

The Six-Wheel Truck with Four Driving Wheels Has Arrived

ONE of the recent contributions to heavy transport is the six-wheel truck having four rear driving wheels and four braking wheels, for which the transportation service of the Quartermaster Corps, U. S. A., claims many decided advantages. Among these are a greater load-carrying capacity with less subsoil pressure, a truck speed up to 55 miles per hour with capacity loads, an increase of tonnage in the same road space with a decrease of load damage, even distribution of the load on four driving wheels, and a great reduction of road shock, as well as counteraction of shock on the vehicle and load.

In recent tests made by Government officials on four-wheel and six-wheel trucks of the same rated capacity, it was found that solid tires on the two drive wheels of four-wheel trucks produce road shocks more than three times as great as with the six-wheel type equipped with pneumatics. During the tests which were conducted by the Bureau of Roads, a rather surprising condition was discovered. Using two trucks of rated 2 tons capacity, one of which was a four-wheeler and the other a six-wheeler, and both equipped with pneumatics, the six-wheeler carried three times the load of the four-wheeler yet produced less road shock. Both trucks were driven 17½ miles per hour in these tests.

The Quartermaster Department has also been surprised to find that the braking efficiency of the six-wheeler made stops possible in a distance of 25 feet when the truck was traveling at a rate of 10 miles per hour. This is half the distance required in which to stop a passenger car equipped with rear wheel brakes only.

All the tests conducted by the Government on six-wheel trucks of the new type where the four wheels in the rear act as drivers and load carriers in equal capacities, have been confirmed by tests made by the Moreland Truck Company, San Francisco, Cal., exclusive Pacific Coast licensees under the Goodyear six-wheel patent. The Moreland Company builds these patented six-wheel trucks up to 10-ton pay-load capacities. It has been found that this tonnage uses up less road space, can be handled at higher speeds, and can be stopped in less distance than lighter loads on the old four-wheeled types.

MORELAND SIX-WHEEL, DUAL-DRIVE, 10-TON TRUCK OWNED BY CONTRACTOR IN SAN PEDRO, CALIF., BEING LOADED BY AN ERIE STEAM SHOVEL

According to Walt L. Moreland, Vice-President and General Manager of the company, this tonnage is handled at considerably less cost on account of the lower investment in equipment per ton-capacity, less driver cost for the same tonnage, and a gain in speed and safety, when six-wheel trucks are used to replace the usual four-wheelers, even when these have been equipped with a supplementary attachment of two idling wheels to reduce unit pressures.

Announcement

P&H

TRUCK *and* TRAILER CRANES

Handling tile or pipe, loading and unloading—placing in trench—all quickly and economically accomplished by means of the P & H Truck Crane or Trailer Crane.

For erecting telegraph or electric power poles and towers, P & H Truck Cranes are particularly suited since they can be quickly driven from one location to the next without loss of time. Whether it's a mile of poles or ten miles, makes no difference.

Building materials of all kinds, including big timbers, I-beams, and other structural members are readily handled by either the Truck or Trailer Crane.

With all the well known P&H advantages of quality construction and long life

Now the contractor, utility, municipal department or supply dealer can get a mobile truck, or trailer crane made by P & H.

The same careful selection of high grade materials—the quality of design and honest workmanship, scientific production methods, employed in the manufacture of P & H heavy duty corduroy cranes, draglines and shovels—insure similar advantages on the new P & H Truck and Trailer Cranes.

Low Operating and Maintenance Costs

The design and construction insure precise and dependable operation—steady service—and economy of effort by reason of the power clutch control which relieves the operator of the heavy work.

Special attention has been paid to accessibility. Any shaft can be removed without disturbing those adjacent. All gears can be readily reached for lubrication and care. Bearings are cast integral to insure permanent alignment of the shafts of meshing gears. The first gear reduction is enclosed in a gear case and runs in a bath of grease. All bearings are provided with industrial Alemite grease cups.

Our new booklet 635-X will be mailed on request

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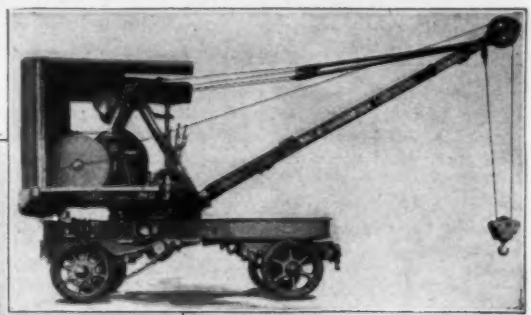
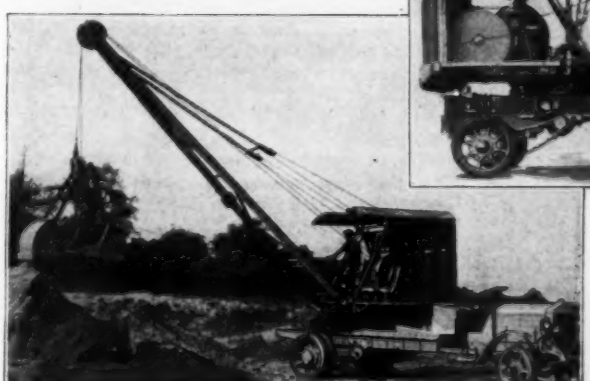




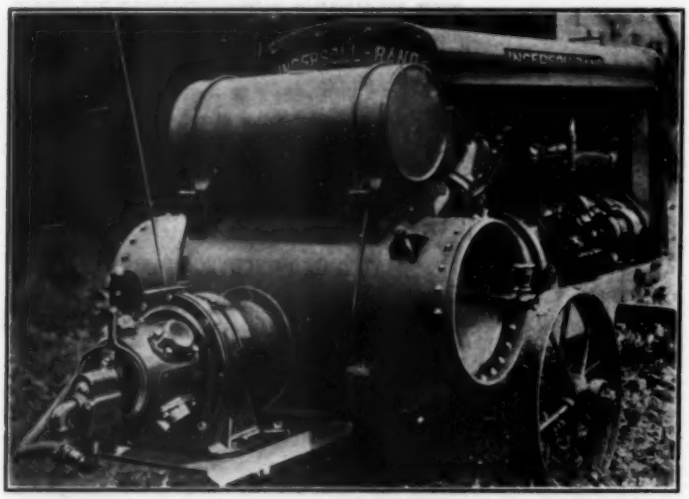
The P & H Trailer Crane is like the Truck-Crane except that not being mounted directly on a truck it is towed to various locations where it is to be used. Any truck may be used for towing and the truck released for other work.

The Truck Crane can be driven from one position or job to another instantly. It can be mounted on the chassis of practically any standard make of 5 or 7½-ton truck, or furnished complete on truck. One P & H truck or trailer crane does the work of 20 to 30 men.

An Air Hoist for Use with Portable Air Compressors

New Utility Air Motor Hoist Is of the Winch Type

A NEW model air motor hoist has been developed by the Ingersoll-Rand Company, 11 Broadway, New York City. This DU "Utility" air motor hoist has been especially designed for use with portable compressors and is suitable for a wide variety of work. It is a hoist of general utility which the road builder can use for hauling or lifting rocks, boulders, and trees from the right of way, for laying culverts, for hauling a scraper when mucking and dragging in materials on small fill jobs, and for any pulling and hoisting jobs which continually present themselves. In trench work the hoist is useful for hauling pipe lengths into position, dragging in backfill, etc. In building construction and repairs it may be used for housing such building material as steel members, building stone, concrete forms, and concrete. It may be used for pulling wire or cables through conduits, for stringing telephone wire, or for moving machinery about the work on any job. It may even be used for hauling the compressor itself a short distance.



AN I-R SIZE DU UTILITY HOIST MOUNTED ON THE REAR OF A PORTABLE COMPRESSOR

The "Utility" hoist is a light, compact hoist of the winch type. It is provided with mountings by which it may be attached to the rear end of a 5½ x 5 or 5 x 5 portable compressor, to the side of larger compressors, or to compressors mounted on Ford trucks. In such cases it is always ready for use and adds but little to the over-all dimensions and weight of the compressor. It is a sturdy, reliable, economical hoist, capable of exerting a rope pull of 1,000 pounds and of taking 350 feet of 5/16-inch cable. A swivel bolt through the bottom of the base permits the hoist to be swung around into any desired position.

This hoist is equipped with a clutch so that the cable may be easily played out by hand or by a down-grade load without turning over the motor and consuming air. A hand brake on the drum is provided to check the unwinding and stop it in any desired position. The throttle control is sturdy and so sensitive that any speed of rope travel can be obtained, from the very slightest movement up to a maximum speed of 65 feet per minute, although carrying a full load of 1,000 pounds at an air pressure of 80 pounds per square inch.

This hoist is said to be very economical of air consumption. Even while lifting a 1,000-pound length of pipe into a trench, the manufacturers state that it can be operated by a 5½ x 5 portable compressor which is also supplying air for a pneumatic digger.

Another Climax Appointment

THE Climax Engineering Company, Clinton, Iowa, has announced the appointment of the Rapp-Huckins Company, Inc., 59 Haverhill Street, Boston, Mass., as district representatives for the sale of Climax engines. The Rapp-Huckins Company is an old and well-established firm which during the last 25 years has handled marine and industrial engines. They maintain a show room as well as a first-class service station in Boston.

Automatic Force Feed moves material rapidly onto belt. No pit under road bed only a trench 14 inches deep.

Sturdy Strength for Steady Service

THE GALION BELT CONVEYOR

Galion Rollers

These include practically every type and size of road roller in use today. Steam and Motor, Macadam and Tandem. The Galion-Fordson Powered Rollers in three types and weights from three to ten tons are proving very popular with contractors.

Galion Graders

Galion Road Graders are made in all sizes in common use, for road construction and maintenance. The line also includes the Galion One-Man Motor Graders.

Other Galion Products

These include Cast Iron Culverts, Corrugated Culverts, Car Unloaders, Gravel and Crushed Stone Spreaders, Gravel Screening Plants, Road Plows, Rooter Plows, Fresnos, Slip Scrapers, Wheel Scrapers, Road Drags, and Blades for every make of drag and grader.

Here is the quick way to unload gravel, coal, crushed stone and similar materials from hopper bottom cars and onto trucks. The Fordson as shown or the Ford Engine mounted on the frame of the Conveyor supplies the power. This Conveyor will also load trucks in the gravel pit by the use of a Galion Grizzly.

LOADS A TRUCK IN LESS THAN TWO MINUTES

This sturdy Conveyor will save you a lot of money and time in material handling. It works rapidly and efficiently and it requires no pit under the track—simply a trench a few inches deep for the automatic force feed, which is supported on railroad ties.

This Conveyor is positive in its action, sturdy in construction, and right in every detail. Ask for facts and figures.

Write for complete information on the Galion machine to meet your needs.

The Galion Iron Works & Mfg. Company, Galion, Ohio

Branches and Distributors in all parts of the country.

The World's Largest Road Machinery Plant

An Improved One-Sack Mixer

Speed and Increased Size Are Featured

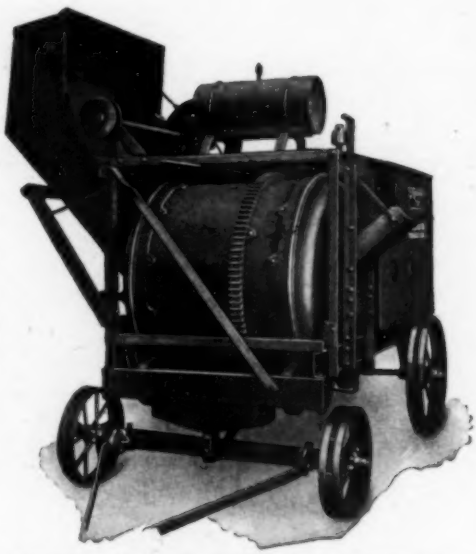
AN improved sack-size No. 10 Republic mixer which holds 12 cubic feet of loose material has been developed by the Republic Iron Works, Tecumseh, Mich. This machine is said to have the largest drum of any sack-size mixer built. The drum shell is No. 10 gage steel.

The skip is built deeper than customary, avoiding the necessity of pounding the skip to discharge wet materials. The mixer action has been materially speeded up, giving a thorough mix in a very short time. The end-to-end action, together with the scattering, showering, and churning, is claimed to be the means of speeding up mixing.

The drum is self-cleaning with no pockets or corners for cement to collect in and harden. The mixing blades and buckets are raised from the shell to insure good scouring action. An innovation in the concrete mixing drum is the installation of drain pipes which are located in each head so that the drum may be washed out and drained, avoiding a dirty mixer.

The mixer is powered with an 8-horse-power engine which is dependable, steady and smooth-running, insuring ample power even after the engine is worn. It is possible for one man to load, wet, and discharge the batch without moving around, as the levers are all located at the front end of the mixer.

The standard mounting is steel wheels, but cushion tires or 24- and 30-inch disc wheels may be installed. The mixer is also built at a slight additional cost with Hyatt roller bearings.

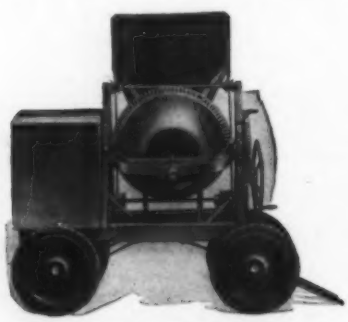


POWER LOADER CONCRETE MIXER OF ONE-SACK CAPACITY

Half-Bag Trailer Type Concrete Mixers

Mixer Built with Roller Bearings, Easy Tilting Mechanism and Fast Discharge

THE Master Mixer, made by the Kiel Mixer Company, 14 Wells Street, Milwaukee, Wis., in the half-bag trailer type, has a capacity of 3½ cubic feet wet and 5½ cubic feet of loose aggregate, in accordance with A. G. C. standards. In order to overcome one of the difficulties which usually cause the first replacements in a concrete mixer, the counter-drive shaft bearings are made dust-proof and are equipped with Timken roller bearings running in oil.



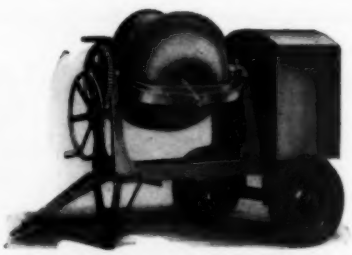
KIEL MIXER ON 4 WHEELS AND WITH POWER LOADER

Another important construction feature is the long bearing spindle, whose great bearing area not only makes it strong enough to support the drum with a full charge of aggregate at any angle, but allows the drum to revolve freely under all side stresses. The tilting mechanism can be easily operated with one hand, as it consists of a large hand wheel, a balanced drum, and a yoke. The large hand wheel has a 7 to 1 gear reduction. A positive lock is conveniently located so that the operator can lock the drum in any position desired. The drum and yoke are so balanced that they automatically come back to position after pouring.

The three mixing blades are set 1½ inches

from the wall of the drum, giving a combined kneading and stirring action. The slat construction provides large water clearances, makes the drum self-cleansing, and materially accelerates the rate of mixing and discharge.

The mixer is set 27 inches from the ground when in discharging position and will clear a wheelbarrow as high as a No. 10-A Sterling. It is also possible to get the barrow under the drum opening whether it is set at right angles or parallel with the machine. The charging height is large enough for easy shoveling, and easy charging and discharging play a very important part in the amount of concrete that can be handled daily.



KIEL 2-WHEEL TRAILER HALF-BAG MIXER

Cleaning Up the Wreck of the Old Madison Square Garden

Power Shovel Makes the Final Knock-out in Old Sport Palace

HISTORIC old Madison Square Garden, scene of many famous pugilistic contests, six-day bicycle races, horse shows, and automobile shows, has finally succumbed to the attacks of power shovels, which are cleaning up the site that a larger and more modern 30-story office building may be built for the New York Life Insurance Company.

The razing of the building, which was completed September 1, was not so much of a job, but the real work started when the excavators bit into the solid rock on which the building stood. The George J. Atwell Company, New York City, is using on the job four Thew steam shovels and eight big derricks, with booms ranging from 72 to 80 feet long, to remove the rock.

The excavation will cover the entire block between 26th and 27th Streets next to Fourth Avenue and will be 73 feet below street level. About 150,000 cubic yards of material will be removed and 125,000 yards of it will be rock.

While this kind of job might seem hard to some, the George J. Atwell Company is used to such problems. Mr. Atwell is one of the best-known foundation contractors doing work in and around New York City, where rock digging is the rule rather than the exception. Mr. Atwell attributes his success in handling big jobs to the fact that he buys his equipment carefully. After he is once satisfied that a machine or material is the best, he standardizes on it and sticks to it. Thew steam shovels, Ingersoll-Rand compressors, and Mack trucks are some of the larger equipment on which he has standardized.

It is the same with his men—he picks the best and then sticks to them. His master mechanic, George Kelly, and his superintendent, Joe Walsh, have been with him for many years.

THEW SHOVELS AT WORK CLEANING UP THE LAST OF THE OLD MADISON SQUARE GARDEN

TRADE MARK
MUNDY
ESTABLISHED 1869

World's Largest Bridge Span

Some of the Bridges on Which Mundy Hoists Have Been Used

1 Brooklyn Bridge, New York
2 Poughkeepsie Bridge over the Hudson River, N Y
3 Omaha and Council Bluffs Bridge over the Missouri River
4 Citizens Bridge over the Mississippi River at St. Louis
5 B & O Bridge over the Susquehanna River at Port Deposit
6 Whipple Bridge over the Ohio River at Point Pleasant, W Va.
7 Union River R. R. Bridge over the Ohio River at Henderson, Kentucky
8 Hell Gate Bridge, New York
9 Bear Mountain Bridge over the Hudson River above Peekskill, N.Y.

To Equipment Distributors.
Some open exclusive Sales Territory is now available.

THE New Delaware River Suspension Bridge has the distinction of having the longest bridge span in the world. It connects Philadelphia, Pa. and Camden, New Jersey, crossing the Delaware River at this point and will be opened to traffic July 4th of this year.

During the construction of this bridge Mundy Electric Hoists were used in the operation of stiff leg derricks handling materials. Sand and stone were delivered to the concrete towers by Mundy 50 H.P hoists for paving the floor of this bridge. A round trip was made in two minutes or 30 trips an hour with a 3-4 yard bucket. The derrick had a very long swing thus cutting down the capacity The maximum height of lift was 25 feet.

Mundy hoists have played an important part in bridge building during the past 56 years. Some of the bridges on which Mundy hoists have been used are listed in this space.

A new book describing Mundy Gasoline Hoisting Equipment has been published. Drop a card for your copy.

The Mundy Sales Corporation

Distributors for the J. S. Mundy Hoisting Engine Co.
30 Church St., New York
Agents in Principal Cities

MUNDY HOISTS

THE HOIST WITH THE ASBESTALL FRICTIONS

A New Single-Cylinder Engine

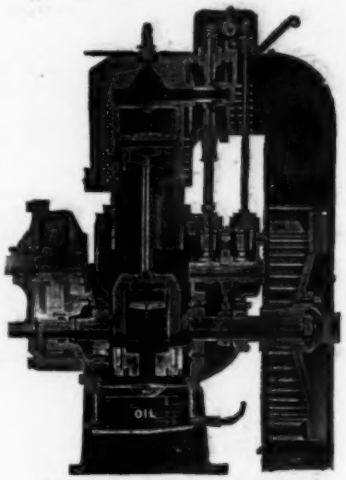
New Unit Weighing Only 300 Pounds Develops from 5 to 8 Horse-Power

A BALANCED 8-horse-power engine, running on gasoline, alcohol, benzine, distillate, or kerosene, with the advantages of a one-cylinder engine consisting of one set of connecting rod bearings, valves, etc., instead of two or more sets, has been placed on the market by the New-Way Motor Company, Lansing, Mich.

This engine has direct cooling by air instead of water cooling. The higher operating cylinder temperature is said by the manufacturers to give better combustion, which makes possible great economies in fuel. The elimination of water and its attendant troubles is another of its economy features. Still another is its light weight, only 300 pounds, and compactness, which means easy portability and lower cost of installation on labor-saving outfits.

The crank-shaft has oversize roller bearings with ⅝-inch straight rollers with a 45-inch end thrust, requiring no adjusting. The distance between main bearings is only 4½ inches instead of 11¼ inches, as on two-cylinder engines of the same rating.

The manufacturers claim that this one-cylinder engine, which is properly balanced, works with less vibration than two-cylinder engines in which the two pistons travel side by side in order to rotate the cycles. This engine has an automatic governor, American Bosch high-tension magneto, a combination force feed and splash lubrication system, a powerful fan, built integral with the fly-wheel, and a power take-off, which supplies half-speed drive which can be operated in any position with a 4 11/16-inch radius.



THE NEW-WAY AIR-COOLED D-2 ENGINE

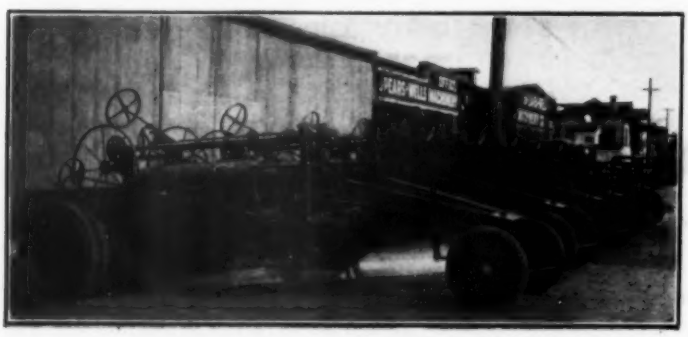
Big Shipment of Grader-Maintainers

California Highway Commission Takes 38 Units for Tractor Operation

THE photograph accompanying this story shows part of a shipment of 28 Spearwell Big-8 grader-maintainers attached to McCormick-Deering International 10-20 tractors which were delivered to the California Highway Commission by the Spears-Wells Machinery Company, Oakland, Calif.

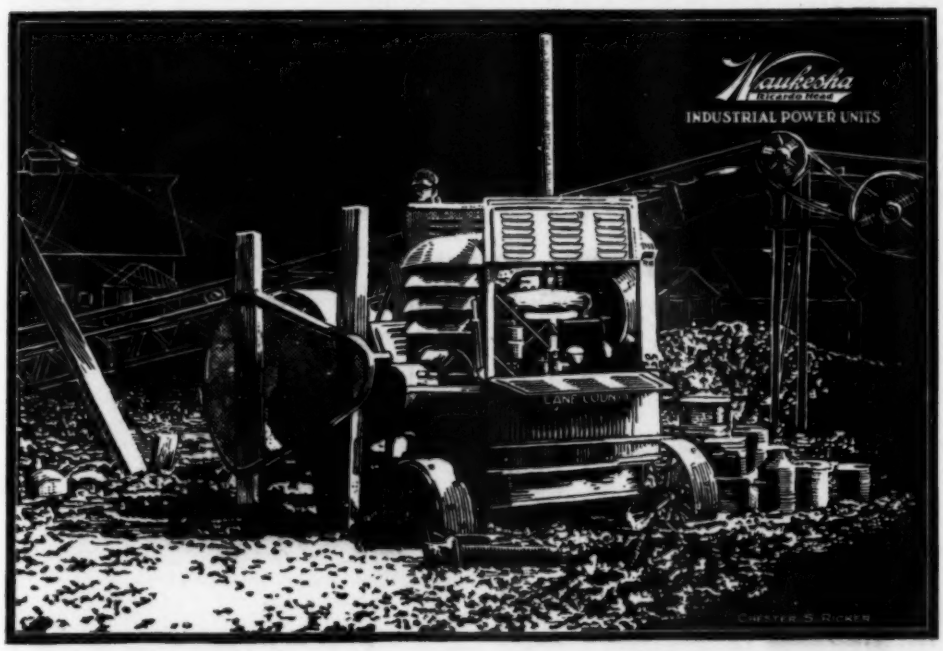
Since January 1, 1926, the Spears-Wells Machinery Company, Oakland, Calif., has furnished the state of California with approximately 30 of these machines in addition to approximately 20 previously furnished for use in maintaining sand- and gravel-surfaced roads and gravel shoulders on state highways.

These grader-maintainers may be seen at work throughout the entire length of the state. Reports from operators and division superintendents state that it is quite feasible to cover from 30 to 35 miles of maintenance per day on dirt and gravel highways, pulling in many cases a 7- or 8-foot



SPEARWELL GRADERS LINED UP READY FOR SHIPMENT

Russell Portable Gravel Plant driven by Waukesha "Ricardo Head" Industrial Power Plant.



Waukesha Helps Cut Road Building Costs

Delivering graded material in the bunkers at 16 cts. per cu. yd. and putting out 280 yards a day is what P. M. Morse, Engr., and Edwin Tuller, Roadmaster, of Lane County, Oregon, did with this portable outfit. Waukesha "Ricardo Head" Industrial Units are ideal for this purpose because of their light weight, reliability, low upkeep expense and ability to run on easily obtained fuel—using little of it.

Waukesha "Industrial Power Units" are all equipped with the patented "Ricardo Head" which gives more power from less gasoline than other motors of the same size. Write for "Industrial Applications" book telling all about these units and the "Ricardo Head."

WAUKESHA MOTOR COMPANY

Waukesha Wisconsin

New York	Kansas City	Denver	Tulsa	Houston	Long Beach, Calif.
Aeolian Building	*V. L. Phillips Co.*	*Wilson Machy. Co.*	*C. F. Camp Co.*	*Portable Rotary Rig Co.*	*Star Drilling Machine Co.*

Exclusive Builders of Heavy Duty Gasoline Engines for Nearly Twenty Years

When writing to advertisers, please mention the Contractors' & Engineers' Monthly—Thank you.

drag in addition to the 8-foot blade on the grader.

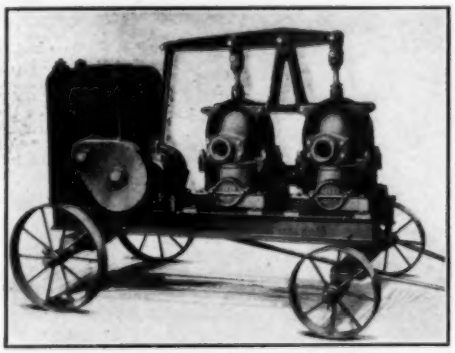
The McCormick-Deering 10-20 tractor made by the International Harvester Company of America, Inc., has ample power for this work and also for full use of the 15-tooth scarifier attachment which the Spears-Wells Company has developed for use with this outfit. The scarifier is especially designed for breaking up the corrugations of dirt and gravel roads, which are the bugbear of engineers, supervisors and road foremen. The teeth are properly spaced to break up the entire surface and form shallow grooves close enough together to provide the lock or bond for the mulch or loose material brought back over the surface by the blade or drag. The controls of the scarifier attachment are very positive and hold the teeth accurately to any depth desired. The mold-board of the Spearwell Big-8 is especially designed and located to eliminate skidding and side-swiping of the grader and to give a maximum of roll and scour to its load and therefore a maximum of movement of the dirt.

Diaphragm Pumping Outfits

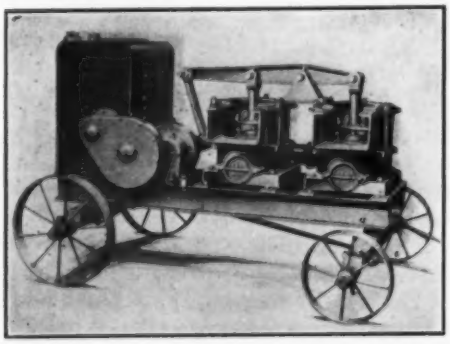
Self-Oiling, Speed-Reducing Unit on Engine Completely Encloses and Protects All Gearing

DIAPHRAGM pumps usually work under conditions not conducive to long life of the wearing parts. As a means of lengthening the life of Novo pumping outfits, the Novo Engine Company, Lansing, Mich., has developed a self-oiling, speed-reducing unit for use on its diaphragm pumps, powered with UF 3-6-horse-power, two-cylinder engines. This unit is completely enclosed, thus protecting all gearing and eliminating many disadvantages of the open-geared type pump.

By using the Novo UF two-cylinder engine, which has a 180-degree opposed-throw counterbalanced crank-shaft running in Timken roller bearings, as described on page 74 of the February, 1926, issue of CONTRACTORS' & ENGINEERS' MONTHLY, Novo has developed what would be called in automobile practice a "De Luxe" diaphragm pumping outfit. These pumps are surplus-powered and smooth-running, minimizing the strain upon the engine and pump, and lengthening the life of the outfit. Both single and double pumps are built in the open and closed types.



A DOUBLE 4-INCH CLOSED-TOP FORCE PUMP WITH A CAPACITY OF 16,000 TO 20,000 GALLONS



DOUBLE 4-INCH OPEN-TOP DIAPHRAGM PUMP WITH A CAPACITY OF 16,000 TO 20,000 GALLONS

O. & S. Changes Name

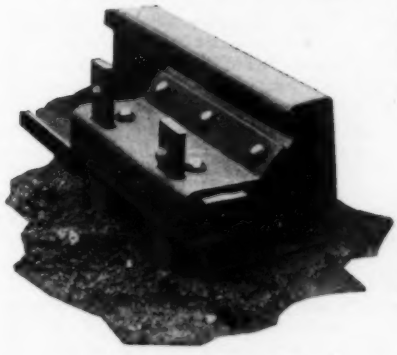
THE corporate name of Orton & Steinbrenner Company, 608 South Dearborn Street, Chicago, Ill., whose factory is located at Huntington, Ind., has been changed to Orton Crane and Shovel Company, with the same addresses. There is no change in the ownership, management, or officials involved, the reason for the change in name being to better describe the company's principal activity, which is the manufacture and sale of locomotive crane, crawling tread cranes, gas, electric and steam shovels, draglines, and grab buckets.

The officers are P. A. Orton, President and General Manager; E. B. Ayers, Vice-President; Herbert Mertz, Secretary; Harry Shaffer, Treasurer; G. L. Niederst, Chief Engineer; Alex Orton, Works Manager; C. C. Case, General Counsel.

New Mundy Distributors

THE Mundy Sales Corporation, 30 Church Street, New York City, in charge of sales of the Mundy line of steam, electric, and gasoline hoists, manufactured by the J. S. Mundy Hoisting Engine Company, 722-740 Frelinghuysen Avenue, Newark, N. J., has announced the appointment of the W. Fred Casey Company, 205 West First Street, Charlotte, N. C., as distributors for the state of North Carolina; Yancey Brothers, 550 Whitehall Street, Atlanta, Ga., as distributors for the states of Alabama, Georgia, South Carolina, and the extreme western part of Florida; Earnest Brothers, Richmond, Va., as distributors for the state of Virginia, and Franklin Taylor, 411 Citizens Bank Building, West Palm Beach, Fla., as exclusive distributor for St. Lucie and Palm Beach Counties, Florida.

More about Mr. O'Connor's Talk on "Cement Overrun" At Chicago Road Show



Quote 1 "The selection of forms suitable to meet the conditions to be encountered is very important. Forms which will serve with certain soil conditions are not fit for use on others."

Heltzel Steel Forms ***meet all*** subsoil ***conditions*** because the stake pockets ***are movable*** and can be moved either way if the stake encounters a stone or other obstruction. If the subsoil is sand or loam, additional stake pockets can be used for each rail section.

Quote 2 "The selection of road forms should be made with the following qualifications in mind:

"Section must be strong enough to take loads with impacts of subgrader and finishing equipment without deflection or distortion, and the areas of base of form sufficient to sustain the required load upon the particular soil encountered."

The Heltzel Road Form has not merely ***one*** reinforcing flange, ***but two—top and bottom.*** 20% stronger than any other steel rail. No rivets or bolts in the rail to weaken its construction.

Quote 3 "Design of form must be such as to withstand side thrust of subgrader and finishing equipment and the lateral thrust of concrete."

Heltzel Flat Stakes, high carbon steel 1⅛" wide have more ***than double the resisting-power to side thrust*** of a round stake ⅞" diameter.

Quote 4 "Staking arrangement should be such as to give added support to side form over and above that provided by the subgrade by means of locking device; a positive and effective method of fastening joints and preventing deflection at that point. Staking method and locking device between forms should also be such as to enable easy readjustment."

The Heltzel Lock Joint is more than ***twice as long*** as any other locking arrangement. It is the only one ***with two stakes 6" apart center to center.*** The head of the rail-joint fits snugly under the tread of the rail and the bottom of the joint wedges tightly against the bottom flange of the rail. Absolutely ***no chance for deflection.*** Absolutely ***no give to side thrust*** of subgrader or lateral thrust of concrete. HELTZEL Rivets are ***more than four times the size*** as the rivets used by others.

HELTZEL Rails are made of 3–16" steel plate with 4" or 6" base.

J. C. O'Connor & Sons bought thousands of feet of HELTZEL Forms

Write for 1926 Road Form Catalog—GET THE FACTS

The Heltzel Steel Form & Iron Co.
WARREN, OHIO

HELTZEL

A Complete Road-Metal Plant

Unit Outfit Reduces All Sizes of Gravel to 1-inch Stone

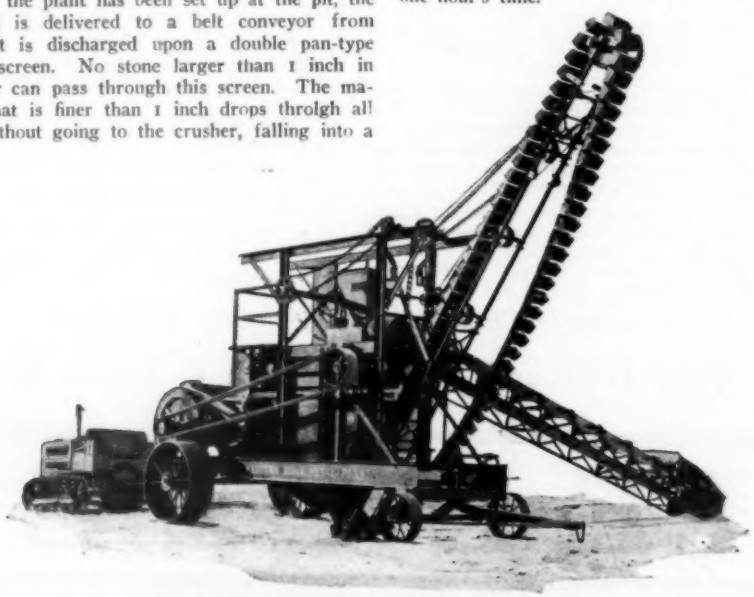
A ROAD-METAL plant made to handle all sizes of gravel and reduce it to a 1-inch maximum, the size required for practically all road surfacing, is being offered by the Austin-Western Road Machinery Company, 400 North Michigan Avenue, Chicago, Ill. It is a complete and portable plant capable of handling 600 cubic yards in 10 hours, 30 per cent of the material being crushed. The use of 1-inch stone in road surfacing is required by most engineers, and surfacing that contains material larger than 1-inch is rejected. How to secure at low cost uniformity in size of material and make certain that no stone larger than 1-inch is spread upon the road is the problem that the contractor has to face.

Where there is a small quantity of over-size stone it is possible to screen out the large sizes, but by so doing the most valuable part of the material would be lost and the advantage would be lost of having the stone broken into shapes that will help to cement the round pieces of gravel and hold them in place. The new Western road-metal plant solves this problem. By no possibility can the plant deliver a piece of stone that is larger than the required 1 inch in diameter. There is no way for the stone to get out of the machine until it has been crushed to the required standard. Anything larger than 1 inch goes through the crusher until reduced to the size that will pass through the 1-inch screen.

After the plant has been set up at the pit, the material is delivered to a belt conveyor from which it is discharged upon a double pan-type shaker screen. No stone larger than 1 inch in diameter can pass through this screen. The material that is finer than 1 inch drops throlgh all once without going to the crusher, falling into a chute and then into the elevator buckets which elevate it to the storage bins. The oversize material moves out over the end of the screen and falls into the crusher. After being crushed it is conveyed by a stationary spout to a short vertical elevator, thence discharged back onto the original screen top, where it mixes with the pit-run material being fed into the plant by the belt conveyor. As fast as material passes through the screen it is discharged by an elevator into a bin or storage pile as desired. The plant has been designed not to have the storage hopper within the plant itself. In that case either the hopper would have to be very small and storage inadequate or the plant would have to be enlarged out of all proportion. A hopper within the plant is soon emptied when there is the least delay, and the teams or trucks then must wait for it to be filled, all of which costs time and money.

The designers of the Western road-metal plant have arranged that this unit delivers its finished product from the top of a 24-foot elevator into a storage bin of 18 to 20 cubic yards capacity, which ordinary delays will not exhaust and from which trucks or wagons can be loaded rapidly and economically.

Notwithstanding the great weight of the plant, it is easily portable. The tractor that drives it can transport it. After the completion of a job the plant can be made ready for transportation in one hour's time.



COMPLETE ROAD-METAL PLANT, TRACTOR-DRIVEN

A New Steel Tower for Hoisting Materials

Towers Built with 20-Foot Interchangeable Sections to a Maximum Height of 300 Feet

TWO types of material hoist towers of steel design have been announced by the Lakewood Engineering Company, Cleveland, Ohio. In the design of these towers, simplicity, interchangeability of parts, and ease of handling have been kept in mind continuously.

The material towers are built in 20-foot interchangeable sections to a maximum height of 300 feet, and take a 7 x 7-foot square material cage of 2,500 pounds capacity, or a half-yard elevator bucket. The towers are square in cross-section, with all the girts, diagonals, and corner posts alike, respectively, thus making complete interchangeability of parts possible and speeding up erection and making storage easy.

The life of a steel material tower, with average care, according to the manufacturer, is easily 15 to 25 jobs or more. Erection costs reported by contractors using the towers run ¾-man-hour per foot on the light type and about 1¼ man-hours per foot on the heavy type tower. First cost, as compared to present wood tower cost, is said to be remarkably low.

A LAKEWOOD STEEL MATERIAL CAR IN SERVICE

A Belt-Type Conveyor with Troughed Rollers

Unit Adaptable to Many Contracting Services

AN automatic conveyor of the belt type which is built in sizes from 12 to 50 feet in length and which may be used suspended from a trolley rail for unloading from the top of cars or hoppers or mounted on a portable wheel frame for unloading from bottom-dump cars directly into trucks, to open storage or into hoppers, is made by the Chicago Automatic Conveyor Company, 908 Old Colony Building, Chicago, Ill.

The belt of the standard conveyor is 18 inches wide, made four-ply with a heavy reinforced carrying surface which runs on troughed rollers. The belt is equipped with steel drags so that it can handle certain materials at a pitch up to 40 degrees. The conveyor has a capacity up to 60 yards per hour and is in all cases equipped with sufficient power to easily handle this load. The conveyor is built substantially and with a receiving end which does not jam when material feeds onto it with great rapidity. The conveyor may be secured with gasoline or electric power, the electric motor being mounted inside of a dust-proof compartment so that it is thoroughly protected. The gasoline engine is mounted on top of the frame, where it is out of the way and yet at the same time easily accessible.

CHICAGO CONVEYOR, SHOWING REINFORCED BELT

Quinlan Made Sales Engineer

STREET Brothers Machine Works, Chattanooga, Tenn., makers of hoists, cableways, derricks, draglines, skidders, etc., have anounced the appointment of R. J. Quinlan as Sales Engineer.

A Time-Saver in Cable Laying

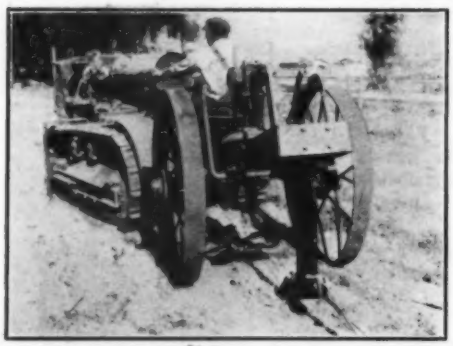
Attachment for Deep-Furrow Plow an Advantage for Contractors

THE No. 20 Killefer, a tool designed by the Killefer Manufacturing Company, Box 606, Huntington Park, Los Angeles, Calif., for deep irrigation furrowing, is now available with an attachment which makes it of particular interest to contractors who may have a cable-laying job in prospect. One St. Louis contractor who saw this tool operate, ordered two of them immediately and estimated that one of them would have saved him $20,000 in the previous few weeks if he had owned it.

The No. 20 and the No. 25 Killefer, which are identical in operation, the first being built for 20 draw-bar horse-power tractors and the latter for 25 draw-bar horse-power tractors, will work to a depth of 20 inches with generous clearance between the frames. There are no braces, draw-bars, or other obstructions used below the frame proper.

The lift is quick and easy and is accomplished without the use of grousers. This permits the use of a smooth wheel, which travels over hard roads with minimum vibration. The lift and drop are controlled by a rope to the seat of the tractor operator. The cutting depth is controlled by the hand crank seen at the top.

A KILLEFER PLACING CABLE UNDER GROUND



KILLEFER WITH ATTACHMENT READY TO START HAULING CABLE UNDERGROUND

A heavy reversible shin protects the front of the standard, holding the points. The points are special oil-tempered steel, and each unit comes equipped with two.

The new attachment permits the burial of cable as deep as 24 inches in the ground. The length of cable pulled is determined entirely by the tensile strength of the cable itself. Where an electrolier is to be placed, a hole is dug and the splice made. This tool greatly reduces the expense, because trench digging and filling is entirely eliminated; the parkway cable is immediately placed under ground, as will be noted in the illustration.

An Efficient Column Clamp

Device May Be Used on Any Shape of Column

A COLUMN clamp which consists simply of an iron strap and a malleable iron clamp which can be used on any square, round, octagon, or any other shape column from 14 inches square to 48 inches square, has been developed by W. A. Kuhlman & Company, 340-344 Water Street, Toledo, Ohio. These malleable iron clamps are dipped to prevent them from rusting and are so light in weight that 50 of them may easily be carried at once, yet they are strong enough to hold and are easy to place on the column. Operators take about one minute to place a clamp on the column. This involves threading the 1¼ by 22-gage iron strap through the slot at the end of the clamp and holding it by a common 30d spike. The strap is then carried around the column and brought back to the other side of the clamp through the drum, which has a slot a few turns of which tighten the strap sufficiently to hold the column firmly. To take the clamp off, it is necessary only to draw up the clamp a little tighter with a wrench, loosen the dog from the drum ratchet, and slip the drum out of the strap.

These clamps have been used on some of the largest buildings in Toledo and in many other places, including the Ohio Bell Telephone Building, the Commodore-Perry Hotel, and the Community Garage Department Hotel, and have brought forth many favorable comments.

ERIE Buckets Aggre-Meter Plants

Erie "Peerless" Bucket. For sand, gravel, crushed stone. Also with teeth for excavating packed gravel, etc. Great closing power. Long cable life. Big load every grab. Quick dumping. All steel. Bushed bearings lubricated by forced feed. Guaranteed.

Type "F" Aggre-Meter. Two sizes, 47 yds. (or 70 tons) and 78 yds. (117 tons) capacity. 47 yd. bin can be shipped on flat car. To erect, just mount on columns and bolt on Aggre-Meters. 78 yd. bin shipped same way simply by removing two sides. Furnished in all steel complete, or with steel frame work only.

Type "E" Plant. For small jobs and street work. Portable. Speedy operation. Loads 1, 2, 3, or 4 batch compartment trucks. Three sizes—15 yds. (23 tons); 20 yds. (30 tons); 27 yds. (40 tons). Just bolt legs in place and bin is ready for use.

For Rapid-Fire Road Building

You can't beat this Erie Equipment for fast, accurate handling, proportioning and loading on road jobs, big and little. Some contractors have as many as eight Aggre-Meter Plants, and the same applies to Erie Buckets. It will be the road contractor—or *any* contractor handling aggregates—who is Aggre-Meter equipped who'll make the most money in 1926.

ERIE STEEL CONSTRUCTION CO.,
Erie, Penna., U.S.A.

An Improved Concrete Barrow

Extra-Strong Wheels and Seamless Stamped Trays Are Features

A BARROW which is designed and built specially for concrete work and which, according to the manufacturer, lifts easier, pushes easier, carries more wet concrete without slopping, dumps easier, and in addition is said to last longer, has been developed by The Toledo Wheelbarrow Company, Toledo, Ohio, in its Bullfrog No. 64 concrete barrow.

The seamless stamped tray has a rolled rim and a high front. It is built smooth and hence is easily cleaned. The tray measures 25 x 38½ inches, and the vertical depth at the handles is 7½ inches and at the wheels 10½ inches.

The heavy angle nose guard ties the frame at the front, and the leg extension at the rear not only prevents handle breakage, but affords an added measure of reinforcement against shock and strain. The high risers let the tray come forward over the wheel so that the wheel takes most of the load. The heavy angle-iron legs are securely bolted to the frame and are equipped with leg wear shoes of malleable iron. The "Never Break" wheel runs in malleable iron axle-boxes which are protected against wear and shock. The handles are of selected hardwood, shaped to fit the hand comfortably, and are air-dried to the proper extent to insure retention of all the natural toughness of the wood, an important factor in preventing splintering or shattering.

THE TOLEDO NO. 64 CONCRETE BARROW

Overcoming Shovel Troubles

Manufacturer Develops Several Unique Features in Hand Shovels

HAVE you ever had a delivery of several dozen shovels and found a goodly portion of the wooden D's broken in shipment? Have you ever had your laborers bring in shovels from the job broken in the handle at the top of the straps or sockets? Have you ever had your shovels broken at the junction of the handle and shovel proper on account of the weakening of a rivet at that point? Have you had laborers bring in shovels that have parted company with their welded strap? If you have had any of these experiences, you may be interested in a new type of shovel which has been developed by the Zenith Shovel Company, 9 South Clinton Street, Chicago, Ill.

A ZENITH SHOVEL, SHOWING CONSTRUCTION

The D and wood grip of these shovels is built up of wood and tubular pressed steel of 18 gage. The grain of the wood grip runs lengthwise and is cupped at the end and securely riveted off center, preventing the grip from turning. The handle is made in two parts divided longitudinally by a steel insert securely riveted at seven points and held tight by a ferrule slipped on and compressed cold into a groove, which makes the ferrule fit the steel insert and handle snugly.

The shovels proper are made of special analysis high-carbon steel heat-treated. The blades and strap are of one piece shaped from sheets. The top of the shovel is turned over, extending up into the socket, giving the blade considerable extra strength and at the same time acting as a step, which saves wear on shoes. Each individual shovel undergoes the Brinnell test, and you will observe the indentation on the back of each blade. The millimeter diameter of the indentation is kept within a definite narrow margin to assure hardness and toughness.

Helpful Material

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

PORTABLE COMPRESSOR FOR THE FORDSON

Bulletin C-4-B issued by the Curtis Pneumatic Machinery Co., 1931 Kienlen Ave., St. Louis, Mo., is more than a mere catalog of specifications of the Curtis-Fordson portable compressor. It contains items showing the actual operation of these units and stories of how contractors are using them most effectively as single units or in groups.

SIMPLE, SERVICEABLE COLUMN CLAMPS

A strong, lasting, yet light-weight, column clamp which can be used on any size or shape of column and which may be put on or taken off in less than a minute, is described in the literature of W. A. Kuhlman & Co., 340-344 Water St., Toledo, Ohio.

SUBSTANTIAL DUMP BODIES FOR TRUCKS

The Superior Body Corp., Marion, Ind., will be pleased to send literature describing its automatic dump body, which is made of heavy-gage steel reinforced at each end, for 17 makes of trucks, and which dumps automatically when loaded, by a pull on the locking lever, and returns to the loading position by a steady pull back on the same lever.

A PORTABLE HOIST FOR FORDSONS

The Pioneer Porta-Hoist, which is mounted on the front of a Fordson tractor so that the entire weight is carried by the front axle of the tractor and which may be used in all kinds of contracting and municipal work, is described completely in a folder which may be secured from Pioneer Tractors, Inc., Winona, Minn.

LIFT AND FORCE TRENCH PUMPS

In its Bulletin No. 279, the Humphryes Mfg. Co., Mansfield, Ohio, describes its line of lift and force trench pumps both of the diaphragm type, suitable for pumping water containing large amounts of mud, sand, grit, and sludge, and of the plunger type, suitable for higher pressures and water without grit.

TESTING MACHINES AND INSTRUMENTS

Catalog 10, Part C, issued by the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., describes and portrays the complete Olsen line of cement, concrete, and road-material testing machines. Other catalogs may also be secured describing other types of machines for various tests in other lines.

A POWER-LIFT ROAD RIPPER

The Killefer power-lift road ripper, which is a superior implement for breaking earth for scraping, grading, bonding, roughing out, or finishing, is described completely in an illustrated folder which has recently been issued by the Killefer Mfg. Co., Box 606, Huntington Park, Los Angeles, Calif.

A NEW PRACTICAL SHOVEL AND DITCHER

A practical and economical shovel for either the big or the small job, equipped with a dependable Fordson tractor, is described in detail in an illustrated circular recently issued by the Law Mfg. Co., Inc., 236 W. 55th St., New York.

A NEW HEAVY-DUTY DUMP-TRUCK

The White Co., Cleveland, Ohio, has just announced a new heavy-duty Model 52-D dump-truck with auxiliary transmission affording the equivalent of five speeds, a new dumping mechanism, and tapered dump body, as well as other features. This is described in literature which may be secured direct from the company.

UNLOADERS FOR STONE, SAND AND GRAVEL

The latest bulletin issued by the Fairfield Engineering Co., Marion, Ohio, describes this company's admirable unloading equipment for crushed stone, sand, gravel, and cinders required for road and building construction.

A NEW EFFECTIVE CONCRETE BREAKER

The Denver Rock Drill Mfg. Co., Denver, Colo., has just announced its new Model-15 Waugh concrete breaker designed to meet the needs of municipalities, contractors, public utilities, and various industries where compressed air demolition tools are desirable, and for use on jobs where drilling and blasting are impractical. This tool is described in literature which may be secured for the asking.

A CHASSIS BUILT TO ENDURE

The Commerce Super-14 2-ton truck chassis, Model 25 2½-ton chassis, and the commerce Super-11 1½-ton truck chassis, are all described in illustrated folders which may be secured without cost from the Commerce Motor Truck Co., Ypsilanti, Mich.

AN AIR-COOLED, 8-HORSE-POWER GAS ENGINE

A new air-cooled New-Way engine which produces 5 to 8 horse-power at 800 to 1,200 r.p.m. has just been announced by the New-Way Motor Co., Lansing, Mich., and is described in an illustrated folder which may be secured by any interested contractors.

A SHOVEL WITH TELESCOPIC BOOM

The Star Drilling Machine Co., Akron, Ohio, in its illustrated folder shows and describes the new Star power shovel, which is lighter in weight than other machines of equal capacity and which has a telescopic boom, making it particularly compact.

A 7-S MIXER WITH POWER SIDE LOADER

The Lansing improved 7-S mixer with power side loader, water-tank, and two-cylinder radiator-cooled LeRoi engine, is described in a catalog, "Lansing Equipment for Contractors," which may be secured from the Lansing Co., Lansing, Mich.

A POSITIVE MEASURING DISC WATER-METER

The King Model B disc meter, which is designed to give long, continuous operation under varying service conditions, is described in catalog G-54 which may be secured from the Union Water Meter Co., Worcester, Mass.

CUTTING CURING COSTS ON CONCRETE JOBS

Dowflake reduces labor costs, furnishes the moisture required, makes possible the quicker removing of forms, lets your capital do double duty, and leaves the concrete clean when used on concrete paving jobs. A helpful booklet on the use of Dowflake calcium chloride for curing concrete roads may be secured from the Dow Chemical Co., Midland, Mich.

ROAD-JOB PUMPING COSTS REDUCED

The Barton portable pump, which saves time and labor, for the car that delivers the pump to the job also furnishes the power to operate it, is described in the literature of the American Steam Pump Co., Battle Creek, Mich.

SMALL, PORTABLE AIR-COMPRESSOR

The Type 55-C Buhl portable air-compressor, capable of operating a small rotator rock drill or one pavement breaker or two clay spades or similar capacity tools, and which has its engine and compressor cast en bloc, eliminating any mechanical difficulties, is described in detail in literature which may be secured from the Buhl Co., 405 S. Dearborn St., Chicago, Ill.

WHEN TO USE LOADING SCRAPERS

Bulletin No. 229 which has recently been issued by the Baker Mfg. Co., 585 Stanford Ave., Springfield, Ill., is intended for road officials and tells how Baker-Maney self-loading scrapers can be operated in most instances by the same force of men that handle the tractor and blade grader outfit in the solution of their many earth-moving problems.

A ONE-PIECE CRUSHING, SCREENING, AND LOADING OUTFIT

The Cedar Rapids one-piece outfit, which crushes, screens, and loads gravel, producing specification material at a minimum cost, and which itself is readily portable, is described in the latest illustrated 18-page catalog issued by the Iowa Mfg. Co., Cedar Rapids, Iowa.

SAVE MONEY FEEDING THE PAVER

The George Haiss Mfg. Co., Inc., 142nd St. and Park Ave., New York, has developed some interesting cost analyses which are published in "Feeding the Paver," a helpful illustrated booklet published particularly for road-building contractors.

A COMBINATION ROOTER AND FURROW PLOW

The literature of the Wiard Plow Co., Batavia, N. Y., describes the Wiard combination rooter and furrow plow, which is converted from the latter to the former simply by removing the steel wing below the moldboard.

LOWER CONCRETE COSTS PER YARD

In road building the paver is one of the principal factors in reducing production costs and making greater profits possible. The Smith 27-E 6-bag paver, which is a steady, dependable, high-speed unit, is described completely in Catalog No. 409-F which may be secured without cost or obligation from the T. L. Smith Co., 1030 32nd St., Milwaukee, Wis.

TRUCKS BUILT FOR THE HARD JOBS

United motor trucks, which are designed and built to perform the extraordinary jobs, that is, work calling for a maximum of power, speed, and dependability in contracting, are described in literature which may be secured from the United Motors Products Co., Grand Rapids, Mich.

CALCIUM CHLORIDE SPEEDS CONCRETE WORK

Booklet No. 2051 which may be secured from the Solvay Process Co., Wing & Evans, Inc., Sales Dept., 40 Rector St., New York, tells how Solvay flake calcium chloride when used as an admixture with portland cement in the construction of concrete roads produces early tensile strength and increases the final strength, setting the interior as fast as the surface, producing one solid mass.

SHOVEL TROUBLE OVERCOME

This is the title of a very interesting booklet published by the Zenith Shovel Co., 9 S. Clinton St., Chicago, Ill., completely describing the new and improved Zenith shovel, which has a tubular pressed-steel D grip, a steel-reinforced handle, and a pressed-steel blade with turnover flare at the top to give I-beam strength.

FIVE MORE HORSEPOWER FOR THE FORDSON

By spending an hour's time installing a Waukesha replacement head on your Fordson, you will increase its power from 3 to 5 more horsepower, thus enabling you to do work in high that formerly required low gear. Booklet "000" giving more information regarding this moderate-priced improvement for Fordsons may be secured from the Waukesha Motor Co., Waukesha, Wis.

DATA ON CABLEWAYS FOR CONSTRUCTION WORK

Contractors all know the work which the cableways were called upon to do in the construction of the world's highest rock-filled dam, the Dix Dam at Burgin, Ky. Further information regarding Street cableways which were on the job throughout the construction of the dam may be secured from Street Brothers Machine Works, Chattanooga, Tenn.

AN IMPROVED HOIST FOR MOTOR-TRUCK DUMP BODIES

The Heil hoist, which requires no tank, weighs less, is simple, compact, and self-contained and handles motor-truck dump bodies quickly and easily, is described in the latest literature of the Heil Co., 1243 26th Ave., Milwaukee, Wis.

BOILERS FOR CONTRACTORS' EQUIPMENT

Boilers for steam shovels, hoists, locomotive cranes, draglines, and other contractors' equipment built to order to meet your individual needs and to meet the requirements of the A.S.M.E. code, Canadian Inter-Provincial or foreign governments, will be found listed in the price list of Johnston Brothers, Inc., Ferrysburg, Mich.

A ½-YARD CRAWLER CONVERTIBLE CRANE

A bulletin describing the Mead-Morrison ½-yard crawler crane, which is convertible for dragline and shovel work and which is a speedy, powerful machine handling a wide range of work economically, may be secured direct from the Mead-Morrison Mfg. Co., 348 Prescott St., Boston, Mass.

DREDGE CHAIN FOR LARGE POWER SHOVELS

Old Reliable "XX" dredge chain, manufactured especially for use on steam shovels, dredges, cranes, derricks, and quarry work and as sling chains for crane use, is described in an illustrated folder which may be secured from the United States Chain and Forging Co., Union Trust Bldg., Pittsburgh, Pa.

CONCRETE AND MORTAR BARROWS

Catalog 12-C issued by the Jackson Mfg. Co., Harrisburg, Pa., describes two of the most popular types of barrows used by contractors and builders for handling concrete and mortar. They have special square front trays with wired edges.

Power *for* Heavy Pulls

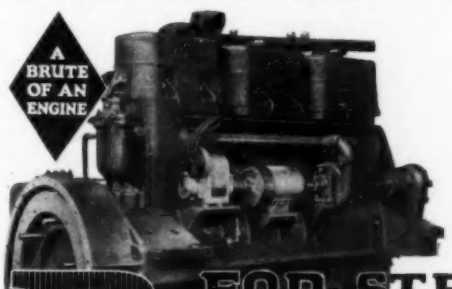
The Beaver Delivers It!

Heavy duty power—the kind that's quick to respond and keeps going every minute. That's the Beaver Engine. And exactly why the Beaver is used so frequently on industrial locomotives. It takes good, steep grades with overloads, and furnishes smooth running and economical power.

This is but one of the many services where the reliable Beaver Power does much to assure the dependable performance of equipment.

The dependability of the Beaver lies in its "quality" construction. Valve-in-head design, gets the maximum power out of every explosion. "Over size" working parts and remarkably vibrationless operation assure a long life of service. The gas consumption is unusually low. Its force-feed lubrication is fool-proof and trustworthy. In every detail the Beaver embodies the best in heavy duty engine construction.

Beaver Engines furnish dependable power to all types of heavy duty construction equipment: tractors, pavers, excavators, power shovels, hoists, and the like. When you buy such equipment, look for the Beaver,—it is an assurance of reliable performance.



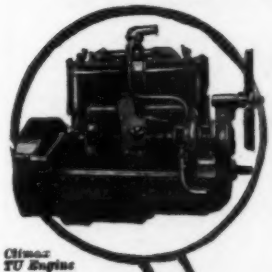
The Beaver is made in sizes ranging from 25 to 150 H. P. Write for bulletin describing Beavers in detail.

BEAVER
Manufacturing Company
50 - 25th Street
Milwaukee Wisconsin

FOR STEADY SERVICE

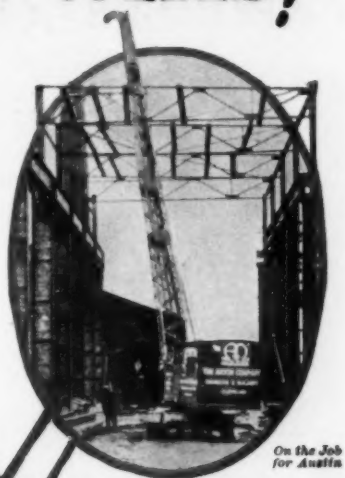
Beaver

"Triple Play" Wins!



Climax TU Engine

CLIMAX
to
BROWNHOIST
to
THE AUSTIN METHOD



On the Job for Austin

From the Climax Engine factory to the Brown Hoisting Machinery Company to power their Gas Creeper Crane, then on to the job of erecting a Million Dollar plant by the Austin Method — that's a "winning triple play."

Austin Buildings must go up right and in record time. Brown Hoist must perform without a hitch. Climax Engines must provide the power abundantly — steadily — and economically.

The Austin Company know they can depend upon Brown Hoist. The Brown Hoisting Machinery Company know they can depend on Climax "Trustworthy" Power.

At the Brownhoist Factory

Write for Bulletins A, B and C

In every line of industry, Climax Engines are establishing an outstanding record for "Trustworthy" service.

Whether you require a Crane, Hoist, Shovel, Tractor, Gasoline Locomotive, Excavating Machine, or other equipment requiring Power, it will pay you well to remember that no machine is better than its power, and that no other Engine has a record of such unfailing dependability as Climax—the "Trustworthy" Engine.

Climax Engines are used as standard Equipment by:

Bay City Dredge Works, Bay City, Mich.
Brown Hoisting Machinery Co., Cleveland, O.
Buhl Machine Co., 606 So. Dearborn St., Chicago, Ill.
Byers Machine Co., Ravenna, Ohio
Davenport Locomotive Works, Davenport, Ia.
Fate-Root-Heath Co., Plymouth, Ohio
Four Drive Tractor Co., Big Rapids, Mich.
Galion Iron Works & Mfg. Co., Galion, Ohio
Greiman Ditcher Co., Inc., Garner, Iowa
Industrial Works, Bay City, Mich.
J. T. Tractor Co., Cleveland, Ohio
Kennison Mfg. Co., Solomon, Kansas
Keystone Driller Co., Beaver Falls, Pa.
Lidgerwood Mfg. Co., New York, N. Y.
Link-Belt Co., Chicago, Ill.
Locomotive Crane Co. of America, Champaign, Ill.
McMyler-Interstate Co., Cleveland, Ohio
Mid-West Locomotive Works, Cincinnati, Ohio
Moore Speedcrane Co., Chicago, Ill.
Mundie Manufacturing Co., Peru, Ill.
Northern Pump Co., Minneapolis, Minn.
O. K. Clutch & Mach. Co., Columbia, Pa.
Orton Crane & Shovel Co., Chicago, Ill.
The Osgood Co., Marion, Ohio
Parsons Co., Newton, Iowa
Rix Compressed Air & Drill Co., San Francisco, Calif.
The Russell & Co., Massillon, Ohio
Vulcan Iron Works, Wilkes-Barre, Pa.
Geo. D. Whitcomb Co., Rochelle, Ill.
Wisconsin Farm Tractor Co., Sauk City, Wis.
W. T. Young Engine Co., Oil City, Pa.

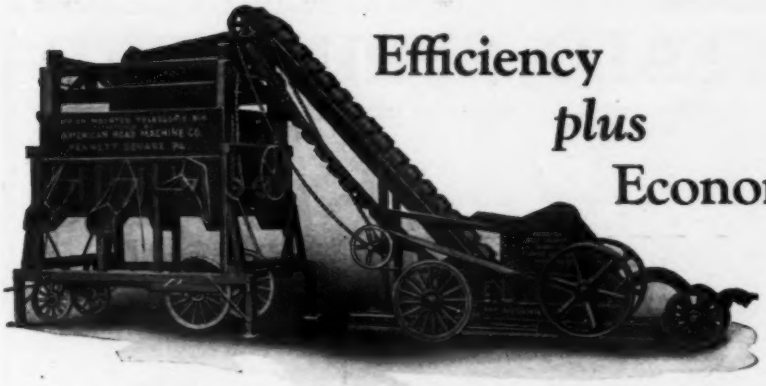
CLIMAX Trade Mark Reg. U.S. Pat. Off.

The "Trustworthy" ENGINE

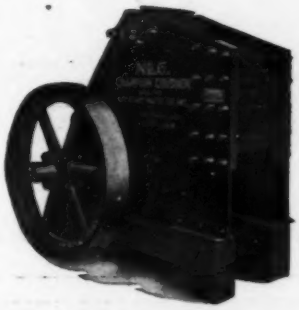
CLIMAX ENGINEERING CO., 1 W. 18th Avenue, Clinton, Iowa

Also Builders of Climax Refrigerating Units

Eastern Branch: 30 E. 42nd St., New York, N. Y.
Cleveland Branch: 607 Leader Building, Cleveland, Ohio
Chicago Branch: 2007 Harris Trust Building, Chicago
Southeastern Branch: Chas. H. Adams, Hotel Hampton, Atlanta, Ga.
Southwestern Branch: P. J. Deasy, Hotel Wells, Tulsa, Okla.
Los Angeles, Calif.: Coast Mach. Corp., 634-36 E. 3rd St.
San Francisco, Calif.: Coast Mach. Corp., 629 Folsom St



Efficiency *plus* Economy



GOOD Roads Rock Crushing Plants—portable or stationary—represent the utmost in efficiency, durability and economy. All over the country, Good Roads crushing equipment is being used—profitably—by contractors, by civic authorities, by quarries. Crushers, elevators, screens, conveyors, bins—all Good Roads—and all working together with precision, to produce the greatest volume at the lowest cost.

Good Roads Portable Rock Crushing Plants are built in various sizes, up to 300 tons daily capacity.

Complete stationary crushing plants of any desired capacity are designed and built by us from start to finish. We assume the whole responsibility.

Write for Crusher Catalog K A U
or Sand and Gravel Catalog 5-A

The
GOOD ROADS MACHINERY CO., Inc.
KENNETT SQUARE, PENNA.

WATERTOWN, MASS. . 36 Pleasant St.
PORTLAND, ORE., 3rd & Hawthorne Sts.
SAN FRANCISCO, CAL. . 26 Fremont St.
LOS ANGELES, CAL., 931 Santa Fe Ave.
CHICAGO, ILL. . . 49th & Halsted Sts.
PITTSBURGH, PA. . . 1523 Oliver Bldg.
ATLANTA, GA. . . . 569 Whitehall St.
NEW YORK, N. Y. . . . 50 Church St.
PHILADELPHIA, PA.,
2037 Commercial Trust Bldg.

Makers of

Revolving Screens — Wash Boxes
Elevators — Elevator Feeders
Dredging Excavators
Dragline Cableway Excavators
Rubber Belt Conveyors
Bins — Chutes and Gates

Good Roads MACHINERY CO. INC.
TRADE MARK

Good Roads MACHINERY

Get the Jump on the Season

Don't wait for "good weather." Jump into that new job with the "Caterpillar"—it has the traction to ride over the soft spots and the power to pull the heavy equipment. That's one way that contractors who own "Caterpillars" "get the edge"—by crowding more contracts into the season.

Prices on "Caterpillar" Tractors:

F. O. B. Peoria, Ill.

SIXTY	$5500
5-TON	3650
2-TON	1950

F. O. B. San Leandro, Calif.

SIXTY	$5500
THIRTY	3400

CATERPILLAR TRACTOR CO.

Executive Offices: San Leandro, California, U. S. A.
Factories: Peoria, Illinois - San Leandro, California
New York Office: 30 Church Street

Successor to

BEST C. L. Best Tractor Co. — The Holt Manufacturing Company HOLT

33-428

CATERPILLAR

Distributors of Contractors' Equipment

THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed. : :

ALA.—ARK.—CALIF.

C. B. DAVIS ENGINEERING CO.

Brown Marx Bldg. Birmingham, Ala.

CRANES
HOISTS
CONVEYORS
BELTS
CRUSHING EQUIPMENT
DREDGES
PUMPS
BUCKETS

REPRESENTING

Robins Conveying Belt Company
Morgan Engineering Co.
Nordberg Mfg. Co.
Wheeler Condenser Co.
Aldrich Pump Company
Bay City Dredge Works
Williams Bucket Co.

JOE LYONS MACHINERY CO.

Contractors' Equipment and Supplies

112 Louisiana St. Little Rock, Ark.

Representing:

REX—Mixers and Pavers
CLYDE — SAGEN—Derricks and Hoists
BLAW-KNOX—Curb, Gutter and Road Forms, Bins, Batchers, Clamshell Buckets, Truck Turntables
RED STAR—Wheelbarrows and Concrete Carts
RED EDGE—Shovels and Picks
BARNES—Pumps and Compressors
NORTHWEST—Shovels, Cranes and Draglines
IDEAL—Concrete Block Machinery and Molds
CLIMAX — LEROI — FULLER & JOHNSON—Engines
OIL PULL—Road Tractors

Also anything else a contractor uses

JOHN D. TURNER

1905 First Ave. Birmingham, Ala.
(Morris Hotel Lobby)

MATERIAL HANDLING EQUIPMENT

REPRESENTING

Barber-Greene Co.—Portable Conveyors, Self Feeding Bucket Loaders, The Ditcher With The Vertical Boom.
Easton Car and Construction Co.—Industrial Cars and Track-Turntables, Roll Over Dump Bodies.
Lakewood Engineering Co.—Concrete Construction and Road Building Equipment.
Nordberg Manufacturing Co.—Trackshifters, Shoveloders.
Northwest Engineering Co.—Crawler Cranes, Draglines, Shovels.
Shaw-Enochs Co.—SHAWNEE Road Builder and Maintainer.
Universal Crane Co.—Truckcranes.
Geo. D. Whitcomb Co.—Electric and Gasoline Locomotives.

The BROWN-BEVIS CO., Inc.

470 East Third Street
Los Angeles, California

DISTRIBUTORS

T. L. Smith Co.—Concrete Mixers, Pavers and Excavators
J. D. Adams and Co.—Adams Leaning Wheel Graders.
Byers Machine Co.—Hoists, Cranes and Truckcranes
Wood Shovel & Tool Co.—Wood Molybdenum Shovels
Lakewood Engineering Co.—Concrete Placing Machinery and Road Finishers
Geo. Haiss Mfg. Co.—Truckloaders and Conveyors
Barnes Mfg. Co.—Barnes Pumps
The Owen Bucket Co.—Clam Shell Buckets
The Buckeye Traction Ditcher Co.—Curb and Trench Ditchers
Watson Truck Corporation—Dump Wagons
Universal Crusher Co.—Crushers.
Traylor Engineering & Mfg. Co.—Rock Crushing Equipment
Monarch Tractors, Inc.
Four Wheel Drive Auto Co.

Member: Associated Equipment Distributors

The Young & Vann Supply Co.

Birmingham, Ala.

Complete line of Contractors' Equipment and Supplies.

REPRESENTING

Smith Concrete Mixers and Pavers
Novo Hoists, Pumps, etc.
Blaw-Knox Steel Forms, Batcher Plants, Clam Shell Buckets
Thew Gas, Steam and Electric Shovels
Baker Backfillers and Unloaders
Archer Concrete Towers
Watson Dump Wagons
Red Edge Shovels and Picks
Akron Wheelbarrows
Carey Elastite Expansion Joint
M. & M. Form Clamps
Jones Superior Machine Co.

Collins-Kay Machinery Co.

438 E. 3rd St. Los Angeles, Cal.

Clark Tructractor Co., Truclifts and tructractors.
Erie Steel Const. Co., Clamshell buckets and aggremeters.
Fate-Root-Heath Co., Gasoline Locomotives.
Koppel Sales Co., Cars and rails.
J. S. Mundy Hoisting Engine Co., Steam, Electric and Gasoline hoists.
Northwest Engr. Co., Gasoline & full Diesel shovels, draglines and cranes.
Northern Engr. Works, Electric overhead traveling cranes.
Deister Concentrating Co., LEAHY No-Blind vibrating screens and concentrators.

The K. B. NOBLE CO.

CONNECTICUT • MASSACHUSETTS

REPRESENTING AMONG OTHERS

RUSSELL: Graders
EASTON: Industrial Equipment.
HAISS: Loaders, Conveyors.
LEROI: Power Units.
"MASTER": Woodworkers.
NATIONAL: Hoists.
OWEN: Clamshell Buckets
PULSOMETER: Steam Pumps.
"REX": Mixers, Pavers.
SASGEN: Derricks.
JONES: Super Woodworkers
SULLIVAN: Compressors, Drills.
UNIVERSAL: Crushers, Bins, Etc.
BOX: Electric Hoists.
"SUPERIOR": Saw Rigs.
"HERCULES": Engines.

Member: Associated Equipment Distributors.

HARTFORD, CONNECTICUT

BURRESS-CLARK MACHINERY CO.

Tampa, Florida

EXCLUSIVE DISTRIBUTORS FOR:

Chain-Belt Co., Rex Mixers
Street Bros., Gas, Steam & Electric Hoists
Barnes Mfg. Co., Power Pumps
Ingersoll-Rand Air Compressors
Lakewood Engine Co., Chuting Equipment
H. W. Roos Co., Rooshors
Jones Superior Saw Rigs
Metal Forms Corp., Metaforms
Sasgen Derricks, Winches, etc.
Blystone Mfg. Co., Plaster & Batch Mixers

COMPLETE STOCK IN TAMPA

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Mathews Gravity Conveyors
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INTELLIGENT PLANNING — PROPER CONSTRUCTION

INDEX TO ADVERTISERS IN THIS ISSUE

(*Continued on page 198*)

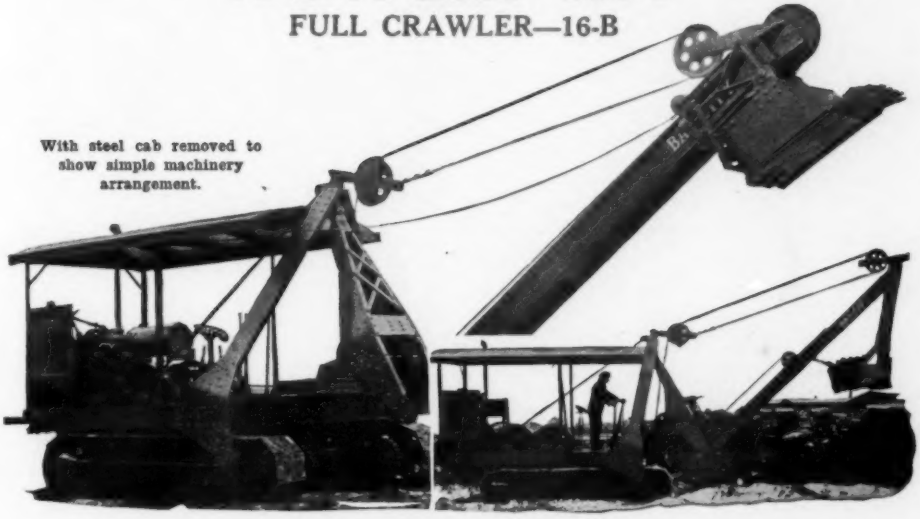
INDEX TO ADVERTISERS IN THIS ISSUE

(Continued from page 197)

For Directory of Consulting & Contracting Engineers, Landscape Architects, Etc., see pages 195, 196.

IT'S A BAY CITY
FULL CRAWLER—16-B

With steel cab removed to show simple machinery arrangement.



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